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Institute of Metals Division Meeting

Annual Winter Meeting in New York, February 17-20 Features Metallography, Aluminum Metallurgy, Theoretical Metallurgy and a Symposium on the Role of Metals in New Transportation. New Officers Elected.

THE Annual Winter Meeting of the Institute of Metals Division of the American Institute of Mining and Metallurgical Engineers was held in the Engineering Societies Building, 29 W. 39th Street, New York, February 17-20, in conjunction with the meeting of the parent body, the A.I.M.E. The meetings were well attended, not only by members of the Division, but by many of the members of the other Divisions who were interested in the varied contacts of the non-ferrous metal industries.

New Officers of the Institute of Metals Division

The following men were elected to office in the Division for the ensuing year.

E. H. Dix, Aluminum Company of America, New Kensington, Pa., for Chairman.

Albert J. Phillips, American Smelting & Refining Company, Maurer, N. J., for Vice-Chairman.

Robert F. Mehl, Carnegie Institute of Technology, Pittsburgh, Pa., for Vice-Chairman.

E. M. Wise, International Nickel Company, Bayonne, N. J., for Secretary.

William H. Finkeldey, Executive Committee for 3 years.

Cyril Stanley Smith, American Brass Company, Waterbury, Conn., for Executive Committee for 3 years.

Lyall Zickrick, General Electric Company, Schenectady, N. Y., for Executive Committee for 3 years.

J. L. Christie, a past chairman of the Institute was re-elected a Director of the A.I.M.E. A biography of Mr. Christie will be found on page 113 of this issue.

Metals Now Rare May Later Be Common

The possibility that metals now considered rare may within the near future be used in large quantities by industry and trade was presented by **Paul M. Tyler,** chief engineer of the Metals and Non-metals Division of the U. S. Bureau of Mines, Washington, D. C. Mr. Tyler pointed out that at the beginning of the present century ordinary industrial needs were supplied by about a dozen metals. Even nickel, cobalt, mercury and bismuth were used only in small amounts and aluminum was just beginning to

progress beyond its former status as a jewelers' metal. Since then the number of metals in active use has more than doubled and research still proceeds at an accelerated pace to expand our knowledge and if possible, our utilization of all the 92 elements.

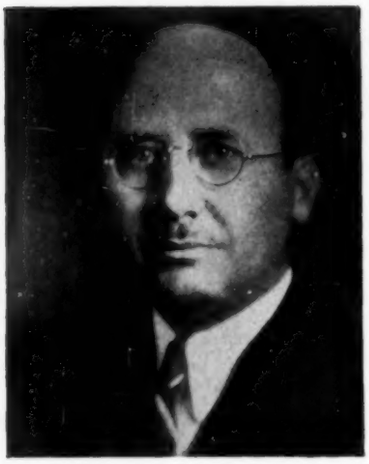
There are those who declare that within a short time we shall have used up our irreplaceable stores of metals and minerals. If this be true, then it behooves us to give more attention to that large group of elements with which we are more bountifully endowed. Of the eleven metals which appear among the twenty most plentiful elements, only iron and aluminum so far have been widely used in the metallic state. Other common, but unused, metallic elements are silicon, calcium, sodium, potassium, magnesium, titanium, barium, manganese, and strontium.

Several metals are so scarce that their actual existence could not be confirmed until long after it had been forecast by the periodic chart of the atoms. However, before admitting that the potential growth of any rare-metal industry is definitely and permanently restricted, consideration should be given two possibilities.

The first is that, since minerals are unevenly distributed in the earth's crust, the rare element may be found concentrated in a large workable orebody. A striking example of such concentration is molybdenum, which has come into prominence largely because huge supplies are found in a single Colorado deposit. Similarly zirconium or beryllium may be found in abundance in some as yet unknown place. No element can be called positively scarce so long as a huge deposit may lie hidden in a remote quarter of the globe.

The second possibility, which may seem too fanciful to mention before practically-minded engineers, is the likelihood of transmutation of elements. The alchemist's dream, scoffed at by 19th century chemists, may yet be brought to actuality. No longer do we consider the atom indestructible. The customary procedure for transmutation today is bombardment with high velocity particles, which is excessively wasteful of electrical energy. But if or when such transmutations become anything more than laboratory phenomena, we may be able to fabricate the elements we want from raw materials blasted out of commoner elements.

In discussing trends in the consumption of metals previously considered rare, Mr. Tyler pointed out that the tendency is toward using larger quantities of relatively cheap alloy metals such as nickel, manganese or chromium, rather than to depend on a high-priced element such as vanadium. However, where a small quantity of a high-priced element radically changes the properties of a common metal (as in the addition of beryllium to copper or tellurium to lead), the price is not so important a factor.



E. H. DIX
Chairman

E. M. WISE
Secretary

ROBERT F. MEHL
Vice-Chairman

CYRIL S. SMITH
Executive Committee

Technical Sessions and Papers

Metallography

The Session on Metallography was held on Tuesday, February 18, at 2 p.m. **Professor Gilbert E. Doan** of Lehigh University, presided with **J. G. Thompson** as Vice-Chairman.

COEFFICIENT OF EQUIVALENCE OF IRON WITH RESPECT TO ALUMINUM IN ALUMINUM BRONZE

By J. L. Bray, M. E. Carruthers and R. H. Heyer

Iron in amounts up to 4 per cent, introduced as such, does not alter the copper-aluminum solid-solution relationships of cast alloys.

Iron in amounts up to 4 per cent, introduced as an iron-aluminum intermetallic compound, does alter the copper-aluminum solid-solution relationships of cast alloys.

The presence of iron up to 4 per cent hastens materially the speed of the eutectoid transformation on cooling.

Iron up to 4 per cent has very little effect on the temperature of the eutectoid transformation.

MICROSCOPIC STUDY OF ANCIENT BRONZE AND COPPER

By C. G. Fink and E. P. Polushkin

In general, the structural peculiarities of ancient bronze and copper are all readily attributable to the crude methods of smelting and treating the metals in the early days of civilization. It is to be noted, however, that the difference between the old and the modern metals is not always very pronounced. There are some examples of ancient metal objects that are almost free from the usual impurities and their structure is normal in every respect.

There is no sign of change in or disintegration of the solid solutions or other components of the metal, except that due to corrosion; this applies even to specimens 5,000 or 6,000 years old.

Microstructural features of initial corrosion and of patina rather than structure of metal give the most reliable proof of the ancient origin of the metal.

Our investigations have disclosed characteristic differences in the initial corrosion of the many specimens of widely different origin or location examined. According to variations in the selective action and in the path of corrosion, six typical cases or distinct types of corrosion of copper and bronze were revealed.

CREEP AND TWINNING IN SINGLE ZINC CRYSTALS

By Richard F. Miller

The results of this work demonstrate the value of creep tests in revealing the limits of the elastic range. Definite evidence was found of plastic deformation with small shearing stresses, in harmony with the requirements of Tyalor's theory of crystal deformation. No indication was observed of a critical temperature T_d below which a much larger critical shearing stress might occur; indeed a remarkable degree of ductility was maintained by the crystals at the temperature of liquid air.

Flexural sliding was found to involve a new type of twinning on second order pyramidal planes.

There appeared to be a large definite threshold stress for twinning on (10-12), which varied inversely with the amount of preceding basal glide. This observation may help to explain the difficulty of previous investigation in obtaining a constant twinning stress at any one temperature.

PHYSICAL PROPERTIES OF SOFT SOLDER AND THE STRENGTH OF SOLDERED JOINTS

By B. W. Gonser and C. M. Heath

The purest solder, electrodeposited and adjusted with Straits tin, gives a slightly higher electrical conductivity through the most used composition range but the differences in conductivity between the solders tested is too small to be of any practical importance.

There is approximately a 5 per cent increase in the electrical conductivity of all the solders upon aging at room temperature for 6 or 8 months.

There is no difference of much practical import as to the tensile and shear strengths among the four classes of solder tested but the more impure solders like the high tin solders of Series D, are slightly stronger and the purest electrolytic or Series C solder is somewhat less strong than the average.

The impact strengths of the solders made from virgin metals and electrolytic solder adjusted with Straits tin are nearly the same and reach a maximum with a tin content of about 40 per cent. Secondary solder containing silver and very small amounts of other impurities has a much higher impact than the other solders in the high lead range. The addition of copper to electrolytic solder appears to definitely injure its impact strength.

In good solid joints there is little practical difference among the four classes of solder tested. However, fire refined secondary solders gave slightly stronger joints and more consistent results with less difficulty due to porosity than other solders.

A method of soldering joints has been devised that practically eliminates porosity and gives satisfactorily comparable results using single lap joints. This consists essentially of flowing solder into a properly prepared wide joint, then forcing the joint members to the desired standard narrow width while the solder is molten.

Aluminum

The Session on Aluminum was held on Wednesday, February 19, at 9:45 a.m. **E. H. Dix, Jr.** of the Aluminum Company of America, presided, with **R. M. Brick** as Vice-Chairman.

EQUILIBRIUM RELATIONSHIPS IN ALUMINUM-ZINC ALLOYS OF HIGH PURITY

By W. L. Fink and L. A. Willey

From this investigation, the breaks in the isothermal electrical resistivity curves clearly indicate the phase boundaries in the temperature-composition diagram. There is one feature of the curves which has not been explained. All of the resistivity curves taken at temperatures above the eutectoid transformation exhibit a break at the eutectoid composition. Inasmuch as this examination was limited to

a study of the solid solubility of zinc in aluminum the significance of this break in the resistivity curves has not been further investigated. It is, however, of interest to note that this composition approximates that of the possible compound Al_2Zn_3 which other investigators have suggested.

It will be noted that the values given in the first part of this paper for the solubility of zinc at 200° C. and 250° C. are too low.

It was found in recent experiments that this was caused principally by extended room temperature precipitation after homogenizing and before powdering. It is believed that the preferential grain boundary precipitation which is known to have occurred during the room temperature aging of the solid specimen, produced heterogeneous powder, i.e., some particles contained more zinc than others. This composition variation was not eliminated by annealing the powder because there was no appreciable diffusion from particle to particle.

DIFFUSION OF MAGNESIUM AND SILICON INTO ALUMINUM

By H. R. Freche

The diffusion of magnesium and silicon from the core into the high purity coating of Alclad sheet is of importance commercially and led to the use of a duplex product for the study of diffusion by means of spectrographic analysis of successive layers.

It has been found that in the duplex materials the diffusion of magnesium from an undersaturated Al-Mg alloy into its high purity Al coating is approximately of the same order of magnitude as the diffusion of silicon from a saturated Al-Si alloy into its high purity Al coating. However, if magnesium and silicon are both present in the alloy in the ratio of Mg_2Si, they appear to diffuse in the approximate ratio of this compound. Finally, if the alloy contains silicon in excess of the amount required by magnesium silicide, the amount of diffused silicon in the high purity aluminum coating will also be in excess.

The interdiffusion of metals in the solid state is both scientific and technical interest, because it is helpful in the study of the alloy structure and in the solution of problems pertaining to the strength and surface condition of the fabricated product.

The present investigation was the direct result of a technical question in connection with alloy fabrication and is a summary of some preliminary work pertaining to the diffusion of magnesium and silicon into aluminum. The results will necessarily be subject to some variations since this is the first attempt to evaluate the coefficients of diffusion of Mg and Si into Al, according to this method of procedure. This method, however, gives definite indication of the relative magnitudes of the rates of diffusion of Mg and Si into Al.

This investigation was carried out on Alclad material. The Mg and Si in the high purity alloy core diffused into the high purity Al coating.

The rates of diffusion of Mg and Si from the alloy core into the high purity Al coating were determined from the quantitative spectrographic data obtained from a series of 0.003 in. (0.0076 cn.) thick steps machined in the Alclad coating. In addition it was also determined by means of quantitative spectrographic analysis how the simultaneous presence of Si affects the rate of diffusion of Mg into Al.

1. When the Mg and Si in the alloy core are present in the ratio of the intermetallic compound Mg_2Si and

2. When the amount of Si present in the alloy core is in excess of the amount required by the compound Mg_2Si.

DENSITY CHANGES IN SOLID ALUMINUM ALLOYS

By L. W. Kempf and H. L. Hopkins

The "growth" of a number of aluminum alloys on reheating in the temperature range 175° (346°) to 230° C. (446° F.) following rapid cooling from a solution heat-treatment has been determined.

The amount of growth of the alloys examined varies between zero and 0.16 per cent, depending on composition and heat-treatment.

The rate of growth under isothermal conditions varies over a relatively wide range with variations in composition.

At a specific temperature of reheating, maximum mechanical properties and maximum growth occur after different periods of time at temperature, the attainment of maximum growth requiring considerably longer periods of time than maximum hardness.

EQUILIBRIUM RELATION IN ALUMINUM-MAGNESIUM SILICIDE ALLOY CONTAINING EXCESS MAGNESIUM

By F. Keller and C. M. Craighead

The presence of magnesium in excess of that required to form the compound Mg_2Si results in a proportional decrease in the solid solubility of Mg_2Si in Al. This information is of considerable commercial value, since the mechanical properties of alloys of the Mg_2Si type are dependent upon the amount of Mg_2Si that can be dissolved during heat treatment and precipitated by artificial aging. Thus in these alloys the presence of any appreciable amount of excess Mg would result in a lowering of the mechanical properties. For this reason Mg_2Si type wrought alloys containing an excess of Mg over that required to form Mg_2Si are of little commercial importance.

Theoretical Metallurgy

The Session on Theoretical Metallurgy was held on Wednesday, February 19, at 2 p.m.

PRECIPITATION HARDENING IN ALUMINUM-BASE ALLOYS

By W. L. Fink and D. W. Smith

Lattice parameter is not changed by precipitation of minute particles during age-hardening as it is by precipitation under equilibrium conditions.

Precipitation can be observed microscopically before the aging has progressed far enough to change the yield strength and elongation substantially.

The anomalous changes in density can be explained by particle size or by the precipitation of a transition phase (θ^1) which has been identified by Wassermann and Weerts and confirmed by the authors.

There now seems to be no justification for modification or complication of the theory of precipitation hardening advanced by Merica, Waltenberg and Scott.

AGE-HARDENING OF MAGNESIUM-ALUMINUM ALLOYS

By A. M. Talbot and John T. Norton

The age-hardening of the magnesium alloys containing about 10 per cent aluminum by weight is due essentially to the precipitation of a second phase from a supersaturated solid solution.

The precipitation takes place very unevenly and may go to completion in one region before a neighboring region has started.

There is no abnormal behavior of the properties measured that indicates the presence of any sort of pre-precipitation hardening phenomena.

THEORY OF METALLIC CRYSTAL AGGREGATES

By Charles G. Maier

Density changes in the cold-working of copper may be either positive or negative, depending on the type of cold-working and the conditions of annealing.

The observed density changes have been partly interpreted in terms of lattice distortion, and the basis for attempting to calculate changes-of-energy content from changes of specific volume have been given.

Changes of energy and heat content due to lattice distortion have been calculated from fundamental thermodynamic equations and shown to be inconsistent with directly determined "stored" energy in torsional cold-working.

The variation of density of iron with cold-working by torsion or drawing is similar to the changes observed in copper, including the presence of a minimum of density observed in the drawing process.

In torsionally cold-worked iron the coercive force and density show a linear relationship attributable to the formation of internal crystal surfaces.

In cold-working by drawing, a linear relationship is observed over only part of the density and coercive-force changes.

Energy and heat-content changes calculated from measured-volume changes by fundamental thermodynamic relationship indicate that the "storage" of energy in cold-working cannot be ascribed to lattice-distortion energy.

On the basis of present experiments, compacted metallic crystal aggregates, as typical of annealed rolled metals, show changes in density that are functional rather than random with further increasing cold-work. The original density in the annealed state may be somewhat random as affected by mosaic-block structure.

Observed density changes are consistent, to a certain extent, with available data on lattice distortion.

It appears logically necessary to describe lattice distortion as the result rather than the cause of changes taking place in the deformation of metallic crystals. If lattice distortion is the result of the changes taking place in cold-working, X-ray and density measurements can be explained only by the existence in metallic crystal aggregates of a certain portion of material of density higher than normal, presumably located in the zones of intercrystalline boundaries and having the nature in part of an absorbed film. This has been termed the "idemsorption hypothesis."

The use of measured changes of specific volume to calculate thermodynamically the expected changes of heat content, entropy and free energy attendant upon lattice distortion shows that thermal changes resulting from such distortion do not adequately explain observed discrepancies between work and heat in the deformation of metals.

A semi-quantitative explanation of observed behavior requires postulation of the existence in the metal of the equivalent of a new phase having a higher heat-and-free-energy content than the lattice. Such a hypothesis differs from the Beilby "amorphous-cement" theory in that the new phase is thought to be a denser absorbed film rather than a supercooled liquid of lower density than the lattice and has little to do with work hardening phenomena except to create at intercrystalline boundaries a potential barrier only partly permeable at ordinary temperatures to atomic dislocation.

The idemsorption hypothesis is not inconsistent with Taylor's dislocation theory of strain-hardening; in fact, it is complementary to it.

DIFFUSION IN SOLID METALS

By R. F. Mehl

The Annual Institute of Metals Lecture

Many critical experiments on diffusion in solid metals remain to be done. Diffusion in solid metals constitutes one of the important fundamental phenomena in metallurgical behavior. Apart from its importance in such processes as chromizing, carburizing, nitriding, and calorizing, diffusion plays an important part in the homogenization, age-hardening and transformation of steel. The scientific importance of diffusion is no less great.

Diffusion may occur within a grain of metal, along a grain boundary, or upon a surface, though the exact and even the relative value of these separate processes are known for only a very few cases.

Some distortion accompanies diffusion, leading to little understood grain-size changes. Distortion assists diffusion though usually it disappears before diffusion has become extensive. In a binary system, the rate of diffusion is the more rapid in the lower melting metal. Age-hardening data on metals may be treated as diffusion data and rates of reaction in steel could profitably be studied from this point of view.

Symposium on the Role of Metals in New Transportation

At the First Session on this subject, held on Thursday, February 20th at 9:45 A. M., Prof. Bradley Stoughton of Lehigh University presided, with Earl C. Smith as Vice Chairman. The following were the contributions to the Symposium:

THE PROSPECTS FOR METALS IN RAILROADS

By A. J. Pelley

What the railroads need as much as anything else is the adoption of a policy, national and state, to stop further legislation or regulations which only add to the cost of railroad operation.

Mr. Pelley outlined some of the experiments now being conducted on the railroads with lightweight equipment, passenger and freight, made possible by new types of metal alloys. In addition to the well-known lightweight passenger trains, of which there are now some forty units in service, he described the construction by the Association of American Railroads of experimental lightweight freight cars. In

one type of car, built with ordinary carbon steel, superior design has made possible a weight reduction of two tons under the former standard car. Other cars, built with alloy metals and weighing six or seven tons less than former cars, are now under test. If these tests are successful a very large field for the use of lighter weight metals will immediately be opened, provided the costs of such metals are not too high.

An upturn in business of as much as 20 or 25 per cent will require, however, the addition of a large number of cars. Recent car orders of steam railroads are evidence of their foresight in planning for the future. The great importance and the large field for increased use of improved materials in equipment construction are readily apparent. However, it must be recognized that the railroads, owning nearly 2,000,000 cars, cannot change their equipment or styles from year to year.

THE HEAVIER NON-FERROUS METALS IN TRANSPORTATION

By C. H. Mathewson

Dr. Mathewson described the major uses of the heavier non-ferrous metals in transportation. He divided the types of uses into four classifications: (1) Machinery and Accessories; (2) Framework and Superstructure and the Line or Travelway; (3) Light, Heat, Power, Water, Sanitary and Housekeeping Services; (4) Embellishment or style.

In the first group the largest single outlet is bearings, using lead, copper, tin, etc. In marine work, however, the largest single piece of metal is generally the propeller-manganese bronze. Marine work in general requires more non-ferrous metals per unit than land instruments of transportation, calling for copper, yellow brass, red brass, Muntz metal, Naval brass, Monel metal, silicon bronzes, Admiralty metal, copper-nickel, aluminum bronze, copper-zinc-nickel, copper-zinc-aluminum, copper-aluminum-tin-zinc and copper-aluminum-nickel-zinc.

Bearings are now used in wide variety: tin base, copper-lead, cadmium-nickel, cadmium-silver, cadmium-silver-copper, lead base (hardened by alkali and alkali-earth metals).

In the automobile, the radiator grille is made of a zinc base die casting and the radiator itself of copper and brass fins, cores and tubes.

One steam locomotive uses as much copper as 100 automobiles and 65 per cent of it represents the copper content of castings for bearing metal, including rod brasses, etc.

Dr. Mathewson touched on the uses of all of the commercial heavy non-ferrous metals and their alloys covering copper, tin, zinc, lead, nickel, including the special alloys, such as beryllium bronze.

USE OF LIGHT METALS IN TRANSPORTATION

By Zay Jeffries

The demand for more economical and more rapid transportation both of passengers and freight is resulting in a continuously increasing use of the light metals, aluminum and magnesium, for transportation equipment. Dr. Jeffries pointed out that substantially all transportation equipment is replaced within a twenty-five year period. In consequence, even though no further expansion in transportation facilities occurs, there still exists a very extensive market for light metals in replacement equipment.

As an instance of the saving to be obtained by employing aluminum, an aluminum truck tank with a 2,400-gallon capacity weighed no more than a 2,000-gallon steel tank when full. Although admitting the selling price of aluminum tanks to be two-and-a-half times the price of a simliar steel tank, a net saving could soon be effected because of the increased payload per trip which the aluminum unit offered.

Aircraft provide the most intensive use of light metals in transportation. In 1929 an average of 1,548 pounds of aluminum was used for each airplane built in the United States. In the first six months of 1935 this had risen to an average of 5,356 pounds of aluminum per plane. Half of the aluminum is used for the bodies, about a quarter for the engines and the remainder for parts.

The success of light-weight passenger railroad cars has whetted the appetite of railroad executives for more. It will probably be some time before a final choice is made among the three leading types now being tried—stainless-steel, aluminum-alloy sheet with airship type of construction, and aluminum-alloy sheet with a more conventional construction style. Although 2,088 units of railroad, subway, and street-car equipment in use in September, 1935, used extensive aluminum applications, less than one hundred had complete aluminum car bodies. In contrast, about 3,000 buses had been built to that date with complete aluminum bodies.

Dr. Jeffries also discussed the use of aluminum in automobiles and in shipbuilding. Because initial cost is an essential factor in pleasure-car construction, he anticipated that cheaper materials would continue to predominate in the auto field. Corrosion resistance as well as weight saving is tending to increase the use of aluminum in marine construction.

The speaker pointed out that magnesium production is only one-fiftieth of the current rate of aluminum output. However, about three-fourths of the magnesium produced is used in transportation, chiefly for airplane, buses, and trucks.

MARINE CONSTRUCTION

By Edgar P. Trask

Mr. Trask showed the gain in efficiency of self-propelled merchant ships when steel of greater elasticity is substituted for mild steel in some of the strength members and aluminum is substituted in some of the non-strength parts of a ship. Aluminum can be used for deck houses and superstructures above the top strength deck, interior non-watertight bulkheads, machinery casing, ventilation trunks, etc.

AIRCRAFT

By H. C. Knerr

Dr. Knerr pointed out that the steel industry seems to have neglected the opportunities in the field of transportation, especially aircraft. A small fraction of the "aggressive and well-directed research" which has gone into the development of the alloys described in the papers of Dr. Jeffries and Dr. Gillett would give to industry a "really light weight" material of construction, moderate in cost, suitable for fabrication, weldable, tough, enduring, corrosion resistant and available from more than one source of supply

TRUCKS AND BUSES

By Merrill C. Horine

Mr. Horine pointed to the fact that the automobile was one of the largest consumers of metals. He stressed the element of speed in the design and construction of automobiles and its effect upon the materials used.

THE RAILROADS

By W. W. Colpitts

Mr. Colpitts spoke on the present situation of the railroads, with particular reference to the prospect for the more general introduction of lightweight equipment. He gave in detail their financial difficulties and pointed out that these difficulties had prevented them from making extensive purchases. Mr. Colpitts praised the new high speed light weight trains and the savings they were showing in dead weight. He listed the alloys, ferrous and non-ferrous used in their construction.

FIFTY YEARS PROGRESS IN ALUMINUM

By F. C. Frary

An After-Dinner Talk at the Annual Dinner of the Institute of Metals Division

The greatest names of science were associated in the quest for inexpensive aluminum, for it was realized that aluminum, if made cheaply enough, would prove of immeasurable value. It weighed only a third as much as iron, it could conduct heat and electricity extremely well, and it was most durable.

Such men as Berzelius of Sweden, Silliman of America, and the great Bunsen of Germany were unable to improve materially on the old process. But Hall and Heroult did, and from their discoveries, made within a few months of each other, dates the aluminum industry.

Heroult was the son of a tanner and his studies in the School of Mines in Paris were interrupted by his father's death, which compelled him to go home to his family in northern France and take charge of the tannery. He had become interested in metallurgy while at Paris, and continued his studies in metallurgy at home, and there, at the age of 22, he made his first aluminum.

At that time there was very little interest in the pure metal, but considerable interest in a beautiful golden copper alloy known as aluminum bronze. His advisers told him there was little future in the pure metal, but a great future for the alloy, and so at first he bent all his energies to the commercialization of his alloy process.

Hall, the son of a Congregational minister in Ohio, had been fascinated by chemistry ever since he was a boy in school. As a child he studied the chemistry text book which his father had read years before, and he dreamed of the new world which this book opened to him.

In Oberlin College, from which he was graduated in 1885, he took only two semesters of chemistry, and his chemical background was far below that of the college graduate of today. His experiments on the aluminum problem carried him beyond graduation, and eight months after he finished school he solved it. He, too, was 22 years old. Neither Hall nor Heroult knew of each other's existence at the time, although in later life they became friends. Continuing this curious parallel, it may be mentioned that both men died in the same year—1914.

Hall found it extremely difficult to capitalize on his invention at first. After two and a half years of fruitless search, he at last made a connection greatly to his benefit. He interested Capt. Alfred E. Hunt, head of the Pittsburgh Testing Laboratory, in his discovery, and Captain Hunt founded a company, in which Hall served as vice president, which was organized for the production of aluminum. Another young man whom Captain Hunt employed in the new company was Arthur Vining Davis, who today is chairman of the board of the Aluminum Company of America.

One of the first activities of the little company was the casting of aluminum cooking utensils. Then came sheet for novelties, wire and cable, bicycle frames and cavalry horse shoes, and a host of incidental products. In the meantime Heroult, with the aid of a German engineer named Kiliani, had converted his original aluminum-bronze plant in Switzerland into a plant for making pure metal, and later started plants in France. These gradually increased in number, and the Swiss company established additional plants in Switzerland and one in Germany. The British Aluminum Company was founded in 1894 and built several plants in England and in Norway. By the beginning of the World War the annual world production of aluminum had reached 180,000,000 pounds.

During the War, several large plants were built in Germany, and their size has since been increased. New plants in the United States, Canada, Italy, and some European countries have been set in operation, and beginnings have been made in the Japanese and Russian production of aluminum. Thus the process devised by Hall and Heroult has spread over all the civilized lands wherever cheap power was available. Cheap power is essential to the production of aluminum, for the industry consumes more electrical power than most other industries.

The art of transporting men and materials has undergone tremendous changes in fifty years, but at present it appears that other important advances and changes, involving both improved service and greater economy, are to be realized by weight reduction.

ELECTROLYTIC SOLDER

By R. P. E. Hermsdorf and Max Heberlein

Electrolytic solders have been made containing from 10 to 45% tin, and a great number of chemical and spectrographic analyses have been made for impurities. A typical spectrographic analysis is:

Cu, 0.001 per cent; Ag, 0.12 oz. per ton, Bi, 0.003 per cent; Fe, 0.001; Ni, 0.0001; insol., 0.0002; Mg, 0.0001; Si, 0.0001; Ca, 0.0001. The following were not detected: Zn, Al, P, As, Au, Ba, Cd, Cr, Ga, Ge, Hg, Li, Mn, Mo and Na. The antimony content of electrolytic solder averages around 0.02 per cent; but since this is lower than many specifications it is often necessary to add antimony, to fulfill the specification of the purchaser.

The electrolytic solder produced by the United States Metals Refining Company since 1927 has been solder to the trade for all the purposes for which solder is used. From these commercial applications, as well as from laboratory tests, it has been found to be very uniform in composition and physical characteristics.

The process used by the United States Metals Refining Company is protected by U. S. Patent 1,842,028, issued January 19, 1932.

Recommended Practice for Common Aluminum-Copper Alloys

A Report of Non-Ferrous Division Committee on Recommended Practice of the American Foundrymen's Association. Presented at the Meeting in Toronto, Canada, August 20-23, 1935.—Part 4*.

D. RECOMMENDED PRACTICE FOR THE COMMON ALUMINUM-SILICON ALLOYS

1. Chemical Control Limits.

Alloy	Percent Cu.	Percent Iron	Percent Si.	Percent Zn.	Percent Mn.	Percent Mg.	Other Elements Percent
B-31[13]	.10 max.[14]	0.80 max.	4.5- 6.0[15]	.03 max.	0.03 max.	0.03 max.	0.03 max. each
B-32	.15 max.[16]	0.80 max.	12.0-13.0[17]	.03 max.	.25 max.[18]	0.03 max.	—

[13]Conforms to U. S. Navy Dept. Specification 46A1c class 2.
[14]A.S.T.M. No. 26-33T Alloy J—0.40% copper max.
[15]A.S.T.M. No. 26-33T Alloy J—0.20% zinc max.
[16]A.S.T.M. No. 26-33T Alloy K—0.30% copper max.
[17]A.S.T.M. No. 26-33T Alloy K—0.20% zinc max.
[18]A.S.T.M. No. 26-33T Alloy K—0.50% manganese max.

2. Physical Properties of Castings.

	Alloy B-31	Alloy B-32[21]
Ultimate Tensile Strength, Lb. per sq. in. (Min. to Avg.)[19]	17000-20000	24000-28000
Yield Strength, Lb. per sq. in. (Permanent Set = 0.2%) (Avg.)	9000	11000
Modulus of Elasticity, Lb. per sq. in. X 10^6 (Approx.)	10	10
Elongation, Per cent in 2 in. (Min. to Avg.)	3.0-8.0	5.0-7.0
Brinnell Hardness, 10 mm ball——500 Kg load (Approx.)	40	50
Ultimate Compressive Strength, Lb. per sq. in. (Approx.)[20]	25000	28000
Specific Gravity (Approx.)	2.65	2.66
Weight per cu. in. (Lbs.) (Approx.)	0.096	0.095
Pattern Maker's Shrinkage—inches per foot	1/10-5/32	1/10-5/32
Solidification Range—°F (Approx.)	1165-1070	1150-1070
Electrical Conductivity (Percent of annealed copper standard at 20°C) (Approx.)	40	35
Endurance Limit, Lb. per sq. in. (R. R. Moore Machine 500,000,000 reversals)	6500	6000
Coefficient of Thermal Expansion per °F X 10^{-6} (Approx.) 68-212°F	12.2	11.3
68-572°F	13.3	11.9

[19]Tension values determined from standard ½ in. diameter A.S.T.M. separately cast test specimens.
[20]Results of tests on specimens having 1/r ratio of 20. All specimens failed by lateral bending.
[21]Modification processes patented U. S. Nos. 1,387,900, 1,410,461, 1,453,928, 1,596,020, 1,570,893, 1,848,797 and 1,848,798.

The presence of the various impurities has an appreciable effect upon the mechanical properties and corrosion resistance of alloy B-31. The corrosion resistance is lowered by the presence of copper and zinc and to a lesser extent by iron. The per cent of elongation is lowered by the presence of iron and to a lesser extent by the other impurities.

Excessive iron content tends toward coarse grain size in the modified (B-32) alloy, which results in inferior mechanical properties. Copper tends to reduce corrosion resistance and impact strength. Silicon above the specified maximum tends to make satisfactory modification difficult.

3. Conforming Specifications.

B-31	Aluminum Company of America	No. 43 Alloy
	Society of Automotive Engineers	No. 35 Alloy
	American Society of Testing Materials	No. B26-33T Alloy J
	U. S. Navy Department	46A1c Grade 2
	U. S. Army Ordnance Department	57-72 Grand 1[22]
B-32	Aluminum Company of America	No. 47 Alloy
	Society of Automotive Engineers	No. 37 Alloy
	American Society for Testing Materials	No. B-26-33T Alloy K
	U. S. Army Ordnance Department	57-72 Grade 8

[22]Minimum Elongation 3.5%.

* Parts 1, 2 and 3 were published in our issues for November and December, 1935 and January, 1936.

4. Development.

The common aluminum-silicon alloys were developed to meet the need for improved casting characteristics and corrosion resistance. Alloy B-31 containing about 5 per cent silicon, because of its fluidity is especially suitable for thin section intricate castings. The alloy is widely used for pressure tight castings. The corrosion resistance of the alloy is appreciably better than that of the common aluminum-copper alloys and for this reason finds use in ever widening fields.

Alloy B-32 containing about 12.5 per cent silicon has somewhat similar casting characteristics to alloy B-31 but better mechanical properties. When cast in sand these properties are only possible through a special "modification" process. This process consists of a controlled addition to the molten metal prior to pouring, of certain modifying agents such as sodium[23].

[23]U. S. Patents 1,387,900; 1,410,461; 1,596,020; 1,848,797; 1,848,798.

5. Field of Use.

Alloy B-31 is used quite extensively for architectural applications such as spandrels, panels, mullions, and ornamental grille work. It is used for some outboard motor and marine fittings, water jackets, and manifolds. There are numerous industrial applications where pressure tightness and corrosion resistance are necessary and the mechanical properties are adequate.

Alloy B-32 finds limited use in this country because heat treated alloy castings with somewhat better characteristics are available. It is, however, being used quite extensively in Europe for automotive, marine, and machine tool applications.

This Report will be continued in an early issue.—Ed.

Alloys Containing Cadmium

Q. —WE are endeavoring to develop an alloy, but due to our inexperience in this particular line of work, we have not had much success, so we wish to avail ourselves of your information service.

The work has not progressed far enough to enable us to say just what the composition will be. However, the following formlua may be taken as an example: iron 70%, cobalt 20%, cadmium 10%. Another example might be, copper 70%, cobalt 20%, cadmium 10%. A cadmium content of at least 10% seems to be quite necessary. As you can readily see, that is what causes the difficulty of making the alloy, since the boiling point of the cadmium is hundreds of degrees below the melting points of the other metals.

We realize that alloys are made which contain a volatile ingredient along with some high melting metals such as phosphor bronze, nickel silver, watch alloy, "Parker's Chrome Alloy," "Aphit" and casting nickel silver. The last two containing cadmium as well as zinc along with copper and nickel. We naturally wonder just what is the procedure of making such alloys without almost complete loss of the volatile elements.

A.—Cadmium is used in the manufacture of Sterling silver but there is no information available with respect to its use in such alloys as those mentioned in your inquiry. When a volatile metal, such as zinc for example, is to be incorporated in a high melting point alloy, it is standard practice to first melt the other constituents of the alloy then add the zinc by plunging it into the molten bath and stirring vigorously. Some loss of the zinc is unavoidable and must be allowed for. The same practice is followed when cadmium is added to silver except that the extreme volatility of the cadmium makes it necessary to use tongs in order to hold the cadmium completely submerged as long as possible.

The boiling point of cadmium is variously given by different authorities as 1432 deg. F. or 1580 deg. F. The lower figure is probably more nearly correct. In either case, it boils far below the melting point of the alloys you have mentioned and can be introduced into them only with great difficulty. When the principal constituent of the alloy is copper, the practice above mentioned should be successful if care is taken to submerge the cadmium. The iron alloy is a real problem since the mixture of iron and cobalt cannot be completely molten at less than about 2600 deg. F. Here the use of previously prepared rich alloys seems essential.

As a matter of fact either alloy can probably be most economically prepared by the use of rich alloys purchased from those skilled in their manufacture. In one case cobalt-copper and cadmium-copper should be added to the bath of molten copper. In the iron alloy, the additions would be ferro-cobalt and probably cobalt-cadmium although this alloy is difficult to make and the problem would be much simplified if cadmium-copper could be used without impairing the properties of the alloy.

It must be borne in mind that cadmium fumes are poisonous. Extreme care should be taken to protect workers against this danger.—**H. M. St. John.**

Brass Founders' Manual Correction

On page 40 of Brass Founders' Manual was given a Table of Basic Specifications for Copper Base Ingots which, it was stated, had been approved and adopted by the Ingot Metal Institute.

This statement was not altogether accurate. It should have read "Standard Specifications as approved by the Code Authority of the Ingot Brass and Bronze Industry." The Code Authority is, of course, no longer in existence, but the Specifications which were generally accepted by the trade are still in force, for practical purposes.

On page 41 was published a set of Specifications for Secondary Aluminum and Alloys of the Aluminum Research Institute. A somewhat similar error was made in this instance. The list of aluminum alloys is simply a classification of finished alloys used by the members of the Aluminum Research Institute in reporting tonnage statistics. The classifications, however, are generally accepted by the trade and for practical purposes, in force.

Porcelain Enameling

By WILLIAM J. MISKELLA

Author of "Practical Color Simplified"

A Description of the Dry and Wet Processes, Raw Materials and Methods of Application

GENERALLY speaking there are two porcelain enameling processes; the dry and the wet. The former is known as the American process and is applied as a rule to cast iron products such as bathtubs and similar plumbing fixtures. After thoroughly cleaning the castings a ground coat is applied consisting of powdered glass, clay and other ingredients.

The Dry Process

As soon as the ground coat is applied the casting is heated so as to fuse it into the metal surface, thereby forming a very thin layer of glass on the outside. Immediately upon withdrawing the product from the furnace the second coating is put on by means of a long-handled sieve. This is known as the cover coat and consists principally of opaque, white powdered glass.

The casting is then returned to the furnace for a short time during which the cover coat is fused on and leveled out so as to produce a perfectly smooth surface. Usually the cover coats increase the thickness of the finish from 1/32" to 3/32".

Raw Materials

The raw materials used in making the various coatings may be classified under three headings; refractories, fluxes and opacifiers. Examples of refractories are cullet, quartz, feldspar, clay, white mica and Cornwall stone. Fluxes include various chemicals such as borax, soda ash, potassium carbonate, potassium nitrate, magnesium carbonate, zinc oxide, dolomite, lime and so on. Some of the the opacifying agents include zirconium compounds, titanium oxide, fluorides, antimony and tin oxides, bone ash and other phosphates.

Knowledge of the methods of manufacture, the chemical and physical properties, impurities the raw materials contain as well as their various reactions in enamels is necessary in order that the enameler may secure satisfactory results. Much of the technique of handling the raw materials and compounds used rests with the individual and quite often the opinions held by certain enamelers are somewhat at variance with the facts.

Feldspar is a popular refractory ingredient of enamel formulae due to its silica and alumina content. It is the principal raw material and is used in larger quantities than any of the other items which make up the mixture. Often in cast iron finishing it is the only refractory used. Increasing the feldspar content makes the enamel less fusible, increases the opacity somewhat and tends to stop crazing, but causes chipping. However, crazing and chipping are usually controlled by simply varying the proportions of soda and potash feldspars.

Sometime it happens that a question arises as to whether a certain lot of material is feldspar or not. It is easy to confuse it with whiting, flint, cryolite or fluorspar. Whiting gives a violent effervescence when treated with hydrochloric acid while feldspar does not. Fluorspar and cryolite when heated with strong sulphuric acid in a platinum vessel give off pungent poisonous fumes of hydrofluoric acid.

Fig. 1. A Modern Porcelain Enamel Plant

Silica as a refractory ingredient renders the enamel less fusible, more resistant to chemical attack and more liable to chipping. Compared with feldspar it makes less opaque enamels, seemingly more brittle.

Both boric acid and borax are used as fluxes in porcelain enamels. The soda in the borax has the same effect as soda introduced by some other means. This material under certain conditions reduces the coefficient of expansion of the enamel which indirectly tends to stop crazing and cause chipping. Sodium oxide has a very decided effect in increasing the coefficient of expansion of enamels and likewise in decreasing their strength and elasticity.

Compared to potash it gives enamels which are less brilliant but which remain soft and ductile for a longer period of time after being melted. When used in

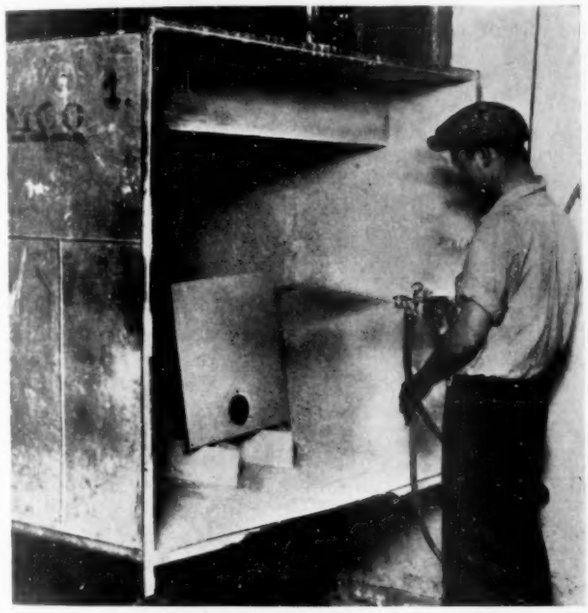


Fig. 2. Spraying Porcelain Enamel on Flat Sheet Steel Parts

large quantities a dull finish enamel results. This is due to the separation in crystalline form of sodium compounds. The amount of sodium oxide that can be introduced as soda depends on the amount of sodium salts used. In general the total amount of free sodium oxide should not exceed 10% of the melted weight of the enamel.

Opacifying agents are divided according to their effectiveness into true and accessory opacifiers. Members of the true group when used alone are capable of making enamels completely opaque while those of the accessory group are used along with one or more of true opacifiers to accomplish this purpose. The true group consists of oxides and other compounds of tin, zirconium, titanium, antimony and arsenic. The various fluorides comprise the accessory group. Contrary to popular belief, true opacifiers are not opaque. When viewed under a microscope in thin sections they are usually transparent.

One of the greatest difficulties in porcelain enamels is the wide variation in colors. They vary from a light brown through yellow, green and into the blues depending upon the composition of the enamels and the heat treatment given during the period of melting. As an example, here is an antimony enamel containing a large amount of lead which gives a yellow color. The Bureau of Standards quotes this formula as one capable of producing a beautiful lemon color.

Potash feldspar	410
Borax	240
Cryolite	120
Sodium nitrate	27
Red lead	255
Antimony oxide	80
	1,132

(When melted this formula shrinks to 1000 parts)

Firing the Coating

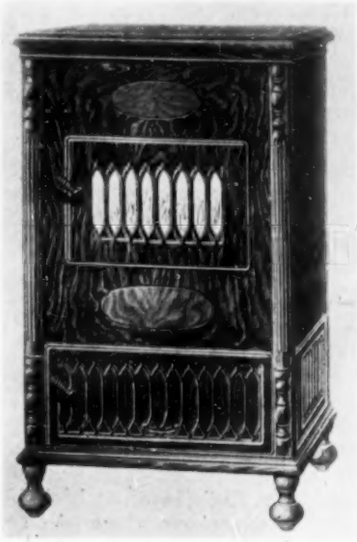
The actual firing of enamel coatings, on bathtubs for example, requires considerable skill. The temperature used runs up to 1800° F, but it is kept down by the process used since every so often a cold cast iron tub weighing 200 pounds or more is put in the furnace. It is withdrawn as a rule three times and allowed to cool considerably each time after which it is again heated. This method of handling keeps those in charge on the alert and insures maximum output while at the same time calling for the skill and extreme watchfulness of the enameler.

Each coat of enamel is melted very quickly—from two to five minutes in a rapidly rising heat. Thus, exposure for a single minute too long in the furnace during one of the heating periods may result in ruin of the piece. This may take form of burning up the slush coat, sulphur bubbles, running off of the enamel and so on. On the other hand, if the tub is not heated sufficiently pinholes will develop and rough uneven coats of poor lustre will result.

The Wet Process

While wet process enameling has been used on cast iron stove parts and the like, the bigger field lies in the coating of sheet iron and steel. Examples of its progress are to be found at every turn, but more prominent and outstanding perhaps at this time are the fine and smooth coatings on refrigerators.

As a general rule the strength of enamels is inversely proportional to the thickness of the coating when properly balanced compositions are used. The heavy coat of enamel used in the dry process is likely to chip particularly on sharp edges and when subjected to impact. The wet process tends to overcome this difficulty, since it is possible to apply the enamel finish in much thinner coats.



Grained Porcelain Enamel Heater

Enameling Steels

To begin with, much of the success of the final finish depends upon the kind of steel used. A typical composition for steel for enameling purposes according to R. D. Landrum is as follows:

S	.040 to .050
P	.030 to .090
Si	.01
Mn	.60 to .040
C	.10

However, there is a wide diversity of opinion regarding the composition of the metal to be used and modern developments are fast changing these opinions.

Being a chemical process it is very important that the surface of the metal to be coated be perfectly clean and free from foreign substances as otherwise the finish cannot be expected to adhere and come out without defects or blemishes of any kind.

Composition of Enamels

The basis of most of these enamels is Si O_2 and the nature of the enamel is materially influenced by the source from which the silica is obtained. Flint and quartz are largely used in compounding enamels but feldspar also plays a very important part because of its Si O_2 content. Silica in the form of flint, ground quartz or sand never melts at the smelter temperature but must be taken into solution by the action of other materials which are melted in the batch. Therefore, feldspar in the batch becomes active as a flux at comparatively low temperatures, thus accelerating the formation of a uniform glass from the components of the batch. A synthetic mixture of materials giving the same resultant product would contain silica and clay and both would retard the melting operation. While the fusibility of the enamel is not greatly decreased by substituting other materials for feldspar, the extra time required for melting, together with the action of the opacifying agents tends to destroy the opacity of the enamel. Feldspar enamels have been shown to be more opaque than those of the same chemical composition without feldspar.

A typical formula for the ground coat used on electrical range parts is as follows:

Borax	34.0
Feldspar	36.0
Quartz	22.0
Soda	7.5
Saltpetre	4.0
Fluorspar	3.5
Calcium carbonate	2.0
Nickel oxide	.25
Cobalt oxide	.25

The formula for the finish coat used in this same plant is as follows:

Feldspar	63
Borax	54
Quartz	38
Soda ash	234
Nitrate of soda	180
Fluorspar	162
Antimony	236
Cryolite	25
Zinc	18
Boric acid	27
Litharge	72
Barium carbonate	38

In preparing enamel slips for application, the frit is ground wet and contains about 5 to 10% of plastic clay for the purpose of floating the enamels. Shaw found that five factors which influence the floating of frits in enamel or glaze slips are:

1. Size of grain of the frit.
2. Specific gravity of the frit.
3. Concentration of the frit in the slip.
4. Viscosity of the floating medium.
5. Amount of the floating medium.

He found that satisfactory substitutes for Vallender clay, a German product, considered essential were to be had in this country for use in floating enamels and preventing them from settling to the bottom of the dipping tank and permitting tempering to the proper consistency to obtain a uniform coating of the desired thickness on the surface of the ware. Tennessee ball clay, Florida clay and Kentucky ball clay were found quite similar to the German product.

Methods of Application

Four different methods are used in applying these enamels: slushing, draining, spraying and dusting. The choice of the method depends upon the size and shape of the ware and the enamel used. Slushing consists of dipping the part into the enamel slip, removing it and shaking it in such a way as to leave a thin uniform coating over the entire surface. Satisfactory results depend upon the consistency of the enamel and the skill of the operator. The draining process although similar to the slushing one requires an entirely different enamel formula. It is used in connection with flat ware such as signs. The spraying method is used to a very large extent and does not require the skill demanded in slushing. Modern improvements in spray guns especially made for the purpose have tended to simplify this form of application and increase its use. Since the movement of the spray gun and not the shaking of the piece controls the distribution of the slip over the surface it is possible to work with higher viscosity enamel.

The dusting method of application while common in cast iron work is used only in steel work of heavy construction. It has a decided advantage in the production of acid-resisting articles because no raw materials are added to the frit, while when any of the other methods of application are used it is necessary to add raw clay and soluble salts to the frit.

A piece of ware that is properly brought up to the finishing coat operation by close attention to all details is quite unlikely to be spoiled in the final operation. Thin coats tend to produce more positive results so the aim should be to keep the enamel as thin as possible.

The drying of porcelain enamel is one of the important steps. The ground coat should be dried as rapidly as possible in order to prevent rusting of the steel. If an alkaline flocculating agent is used for tempering the ground coat, it can be dried in the open air without serious rusting, but if chlorides and sulphates are used rusting is sure to result. This rust may be visible even after the coating has dried or it may appear in the form of spots where the iron oxide has reacted with the enamel. When such spots are formed it is practically impossible to cover them with enamel and they will show up in the finished article either as dark spots or pits.

After the ground coat has been dried at a comparatively low temperature the parts are ready to go into the muffle furnace. In the case of heavy wares an open furnace is used. The parts are usually set on pointed projections and those of approximately the same size and weight are put through at the same time. The temperatures used vary widely but the general practice is to burn the ground coat at a higher temperature than the finishing coats.

Zinc Plating

By C. M. HOFF

Grasselli Chemical Company,
Cleveland, O.

The Large Increase in the Cost of Cadmium Makes It Advisable to Consider Zinc Plating for More Uses.*

DUE to recent increases in the price of cadmium and the scarcity of this metal, it is important that consideration be given to zinc plating.

Many specifications have been given in the past permitting zinc or cadmium to be used, providing certain conditions could be met. Many of these specifications are not based on thickness, but on salt spray tests. Unfortunately salt spray tests and outdoor exposure tests on both cadmium and zinc seem to have very little relation. One condition, however, was especially noticeable and that was in the salt spray test based on equal thicknesses of deposit, cadmium would last many times as long as zinc, whereas under outdoor exposure tests the life of cadmium and zinc seemed to be more nearly equal. As a result of these tests, the United States Government in specifying metallic protective coatings for use on airplanes where this equipment was used on salt water or near the seacoast, invariably specified cadmium, and, undoubtedly, will continue even though the price of cadmium is high, in view of the fact that under these conditions of use, several times more thickness of zinc than cadmium would be required to provide equal protection; and if zinc were used, it would require under-cutting the threads on practically all the products that were zinc plated.

In comparing cadmium and zinc and their application, the following properties of the two metals should be considered:

Cadmium

Atomic weight, 112,409; Baxter and Wilson, J. Am. Chem. Soc. (1921).

Valency, 2.

Electrochemical equiv., 0.5824 Mg. per coulomb, or 2,096 g. per amp. hr.

Specific gravity (cast), 8,604; Strohmeyer Schweigg Journ.

Specific gravity (hammered) 8.694; Strohmeyer Schweigg Journ.

Specific heat, 0.0576; Dulong and Petit, Ingalls, p. 580.

Specific resistance, 6.2-7.0 michrohms per c. m. c.

Latent head of fusion, 13.00 cal.; Budgeon.

Melting point, 320° C.; Journ. Franklin Inst., 174,227.

Boiling point, 785° C.; Ruff and Borgdahl, Zeit. Am. Chem. (1919).

Tensile strength, 13,660 lb. per sq. in. (4,667 kg. per sq. cm.); Hoffman.

Elongation, per cent, 44.0 at above breaking point; Hoffman.

Hardness (annealed), 21.3-25.5 Brinell Scale.

Coefficient of expansion, 0.0000306 linear, 0°-100° C.; Budgeon.

Zinc

Atomic weight, 65.37; Olsen.

Valency, 2

Electrochemical equivalent, 0.3388 mg. per coulomb, or 1.2194 g. per amp. hr.; Gore.

Specific gravity (cast), 7.142; average values.

Specific gravity (rolled), 7.25; Ingalls.

Specific heat, 0.09356; Olsen.

Specific resistance, 5.56-6.04 michrohms per c.m.c.; Hoffman.

Latent heat of fusion, 22.60 calories; Hoffman.

Latent heat of vaporization, 446.00 calories; Hoffman.

Melting point, 419.4° C.; Olsen.

Boiling point, 930.0° C.; Olsen.

Tensile strength, 3-17,000 lb. per sq. in.; Liddell.

Hardness (annealed), 25.0-30.0 Brinell Scale.

Coefficient of expansion (linear), 0.00002918; Olsen.

Table for Electrodeposition

	Cadmium	Zinc
Electrochemical equivalents:		
Milligrams per coulomb	0.5824	0.3388
Grams per amp hour	2.0960	1.2194
Weight per unit area:		
Gr. per sq. dm. for 0.01 in. in thickness	0.8604	0.7142
Oz. per sq. ft. for 0.001 inch thickness	0.7163	0.5946
Thickness of deposit:		
Per 1 amp. hour per sq. dm.	0.002436 cm.	0.001707 cm.
Per 1 amp. hour per sq. ft.	0.0001031 inch	0.00007231 in.

We shall not attempt here to indicate what we would consider comparative specifications of cadmium and zinc deposits with respect to the thickness inasmuch as individual manufacturers will probably draw their own conclusions from several sources, including the specifications of the Government for airplanes and the results of the A.S.T.M. tests and the Research Division of the American Electro-Platers' Society tests as well as the results of their own experience with the two metals.

What we are primarily interested in considering here is the comparison between the two metals as regards the time required for depositing a certain thickness of metal, the relative size of equipment, capacity of equipment, stability of solution, current efficiencies, current densities, etc.

Referring to the data in the table for electrodeposition previously given, it will be noted that one amp. hour per square foot at 100% current efficiency will deposit .0001031 in. of cadmium and .00007231 inch of zinc. If we assume that both cadmium and zinc solutions are operated at the same current efficiency and plate with the same current density, it would take between 14 and 15 minutes to deposit with zinc the same thickness of metal as would be obtained with cadmium in 10 minutes' time.

Most alkaline zinc solutions used heretofore operated at lower current efficiencies and lower current densities than with cadmuim. However, recent developments have resulted in bright zinc solutions operating at relatively high current efficiencies and at current densities comparative to cadmium. For example, in our bright zinc average current densities

* A paper read at a recent meeting of the Master Electro-Platers' Institute of the Midwest.

of 30 amp. per square foot are employed with a wide current density bright range and current efficiencies approaching that of cadmium solutions. We can assume then for all practical purposes that it will require one and one-half times as long or 50% greater time to deposit the same thickness of zinc as is required for cadmium.

The alkaline-cyanide-zinc solution is almost entirely used for rapid zinc plating due to the fact that it has a high throwing power and lends itself more readily to producing bright deposits. The sulphate-zinc solution, while simpler and cheaper, has an extremely low throwing power and is used to very little extent where zinc is required for rust protection.

Inasmuch as alkaline-cyanide-zinc solutions are almost universally used the same type of equipment that is used for cadmium plating can be used for zinc plating, which, of course, is extremely desirable where it is necessary to change from a cadmium plating solution to a zinc plating solution. Steel tanks are suitable for this purpose for all still plating and variable speed and automatic conveyors, and for barrel plating, steel tanks or rubber-lined steel tanks, and the barrel may be constructed preferably of Formica or other satisfactory Bakelite compounds or of hard rubber.

Bright Zinc Plating

I do not attempt to give any general idea or specific information pertaining to all the different bright zinc processes that are available as they differ considerably (some requiring alloys of one or more metals with the zinc anodes) but will confine the following comparison of costs to our own bright zinc, which process operates at relatively high current efficiencies:

Used on still plating an average current density of 30 amperes per square foot, operates at normal room temperature and is a stable well balanced solution, using high purity, non-alloy zinc anodes.

A comparison of costs naturally must be based on the thickness of deposit specified in zinc or cadmium. Just for the sake of comparison assuming that the same thickness of either metal is required we have for a given amount of work the same labor required for the plating, the same labor in the plating operations, as well as the subsequent rinsing and drying operations.

However, 50% more equipment will be required for zinc plating; or looking at it from the other angle, the same equipment will have but about two-thirds the production with zinc as it would for cadmium, which, of course, increases the overhead cost and may in many cases increase the labor cost, due to the fact that a certain number of men are required for handling the product irrespective of the quantity involved. To take care of the same production of zinc as in cadmium about 50% greater size of plating equipment, including the plating tank and motor generator set, will be required.

These two factors are the ones which will have the greatest bearing on the relative cost of cadmium and zinc, the decreased production on the same equipment with zinc being offset by the lower cost of the zinc anodes and zinc solution, and substituting these new values in your present cost for cadmium will enable you, to a fair degree of accuracy, to determine what your probable cost will be with zinc.

When appearances are considered, zinc does not ordinarily have the bright and attractive appearance of cadmium, not the white color, nor does it last ordinarily as satisfactorily without cloudiness under atmospheric conditions.

In this connection, a bright dip has been developed for zinc which adds greatly to its brilliancy and uniformity and greatly lessens its tendency to tarnish and finger stain in handling. This, of course, has been somewhat true of cadmium, especially where mat or semi-mat finishes were obtained, but it is possibly still more important in zinc which is a more active metal and consequently more quickly tarnishes unless protected with a passive film.

It has also been found desirable to rinse freshly zinc plated parts very quickly and thoroughly with clean water in order to prevent staining from the solution. This, of course, is true of cadmium plating as well, but in the case of zinc, the latter being a more active metal and more quickly displacing other metals from the solution, quick and thorough rinsing is quite important.

Silver to Protect Steels During Annealing

In the course of some recent work at the National Bureau of Standards, Washington, D. C., which required the full annealing of both medium carbon and high carbon steels with the utmost protection against oxidation or decarburization of the surfaces, it developed that silver coatings are a satisfactory means to accomplish this end, although probably not so well known or so widely used as are other methods of protection.

Polished mild steel surfaces bearing finely engraved designs may be coated with a thin electrolytic deposit of silver, annealed, and the silver stripped electrolytically, leaving the steel surface in practically its initial condition. Electroplated silver has also been used to protect rather thin section, high-carbon steel pieces during annealing with assurance that the insolubility of silver in iron will prevent modification of the chemical composition of the steel by penetration of the silver.

Effect of Surface Treatment on Metals*

It is well recognized by materials-testing engineers that the measured properties of a metallic material may be decidedly influenced by the character of the surface of the test specimen.

However, that some surface **treatments** may also affect certain properties of a metal, at least as ordinarily determined. The effect appears to be most pronounced when the ratio of surface area to volume of metal is relatively large, as in wire. Recent endurance tests of wire by the pulsating tension method at the Bureau showed that an increase in the endurance limit of wire (hot galvanized and approximately 0.2 inch diameter) of over 100 per cent was obtained by removing the surface metal, the thickness of the layer removed being equivalent to somewhat over 10 per cent of the initial diameter. This is no indictment, however, against hot galvanizing.

*From the Technical News Bulletin of the National Bureau of Standards, December, 1935.

Barrel Burnishing

Due to the Scarcity of Good Literature on Barrel Burnishing this German article by Dr. F. Schwarz "Das Polieren in Trommeln" from Oberflachentechnik, Vol. 12, No. 20, 1935, Pages 243-247 Has Been Extensively Abstracted.*

By WALTER R. MEYER

General Electric Company, Bridgeport, Conn.

BARREL burnishing is primarily intended for bulk work to replace the expensive and more troublesome hand buffing. The soft metals such as copper, brass, zinc, silver, aluminum and its alloys are easily burnished but the harder metals such as cast iron, steel, bronze, etc. are more difficult. Copper, brass, nickel, and cadmium plated bulk work may be burnished to a high luster, but chromium plated ware is burnished with considerable difficulty.

Barrel burnishing may be divided into several types of technique, namely:

1. Dry burnishing in which mostly dry burnishing agents are used.
2. Wet burnishing in which soap solutions or solutions of burnishing salts are used.
3. Ball burnishing usually in the wet way.
4. Scouring by the use of etching agents such as acids with the addition of coarse abrading substances such as sand. This last method is really not burnishing in the usual sense, but is a cleaning and scale removing process previous to burnishing.

The size and form of the burnishing barrel depends largely upon the type of work to be treated. They are usually made out of hard wood such as beech, although iron is sometimes used, and they are round or of many corners. The long narrow barrels run at higher speeds than the shorter larger diameter barrels. The larger diameter barrels burnish faster because of the greater pressure of the work, but they require consequently more power to run them than the long barrels.

Mechanism of Burnishing

The process of barrel burnishings is of a complicated nature, consisting first of an abrading action in which the minute protections are worn off with some plastic flow. This action is followed by a pressure homogenization of the surface in which the repeatedly applied pressure works the higher points into the minute grooves resulting in a more or less mirror-like surface. This is analogous to the pressure polishing of gold and silver in which a mirror-like surface is obtained without removing any metal. Both of the above actions are accompanied by an etching process which keeps the metal free from oxide. A burnished surface consists, therefore, of a severely cold worked layer of metal with a very fine crystalline structure. Such surfaces have greater resistance to chemical attack or corrosion than the unburnished metal.

Articles weighing over a pound may be burnished in barrels by fastening the work in the barrel. (See R. J. O'Connor, Met. Ind. N. Y., 29, 1931, 523). The form of the work to be burnished is very significant as certain shapes nest together and will not separate during the rolling while other shapes may have sharp corners or thin sections which preclude a barrel treatment.

Scouring

Scouring or removal of oxides or scale is usually done in a watertight, hard wood, cylindrical barrel. The work is put into the barrel with sand and sulphuric acid to make a 1-5% solution of acid and tumbled from 30 to 60 times a minute. Sharp sand will be much more effective than the round sea-sand. Brass and bronze articles usually require from 10-12 hours burnishing; steel, 20-30 hours; and cast iron from 40 to 60 hours. The barrel should be opened every 5 hours, and the work examined but new sand should not be added as the sharp edges may scratch the surface of the work. The iron articles upon completion of the scouring are removed, dipped in 10% sulphuric acid and then transferred to another burnishing barrel. In some cases a dry scouring tumble is used after the wet scour in which sea-sand, leather scraps, or pumice is used. Scouring is seldom done on aluminum or zinc die castings or on pressed stock.

Wet Burnishing

Wet burnishing without balls is only for that class of work which by virtue of its own weight can exert enough pressure for a burnishing action. Cavities will not be burnished in this process. Wooden barrels are rotated from 30 to 50 times a minute and care must be taken to completely cover the work with water. It is usually a good plan to have the water level at least one inch above the level of the work.

The burnishing agent has several functions to perform. It first must serve as a gliding agent so that the pieces of work can slide over one another without a strong abrading action. At the same time it must not allow the metal chips to be emulsified, and it must clean the surface of the metal. It must also have a slight etching action to remove any oxides and to prevent oxidation. The most important agent in the solution is the gliding agent as the finish is the best when the polishing action is at a maximum and the pressure burnishing is at a minimum.

Soaps were formerly used alone as burnishing agents, but their tendency to form metallic soaps and their lack of an etching action necessitated frequent renewals at considerable expense. O. Hahn recom-

*From The Monthly Review of the American Electro-Platers' Society, December, 1935.

mended the addition of sodium cyanide to the soap with an improvement in results. Additions of boric acid, borates, citrates, tartrates, and oxalates have all been recommended. Soap solutions with additions of one of these materials can be used several days for burnishing. If the soap foams too much, an addition of alcohol will greatly reduce the foam.

During the last few years the soap solutions have been replaced by neutral wetting agents such as sulphated alcohols, esters of fatty acids, or fatty acid derivatives and oxyalkyl sulfonic acid derivatives. These substances are more stable than soap, but they also require a mild etching agent to remove oxides. Some specific burnishing solutions are as follows:

For Aluminum—	
Acid potassium or sodium fluoride	.7 oz. gal.
Igepon or Nekal	.13 oz. gal.
Sodium bisulphate	.5 oz. gal.
For Iron and Steel—	
A Basis Solution	
Soap flakes	.5 oz. gal.
Soda ash	2.5 oz. gal.
Sodium cyanide	.7 oz. gal.
For Copper and Copper Alloys—	
Soap powder	.4 oz. gal.
Soda ash	.3 oz. gal.
Sodium cyanide	.13 oz. gal.

Ball Burnishing

Ball burnishing is particularly valuable for recessed or sharp work. The same burnishing agents that are used in the wet process just discussed can be used for ball burnishing although the burnishing can also be done dry. The quality of the ball used plays an important part in securing a good finish. The most satisfactory are the hardened, highly polished chrome steel balls, whereas the cast ordinary ball offers some specific difficulties. They do not have the highly polished surface of the steel balls, and they are liable to crack during the tumbling causing scratches on the work. The size of the ball to use naturally depends upon the size of the work and of the recessed portions on the work. Jacks and variously shaped steel slugs are often necessary for small openings or for work with difficultly accessible recesses. The balls must be kept scrupulously clean and free from rust, and the work must be completely imbedded in the balls. For best results the quantity of balls should be from two to five times the quantity of the work. The barrel should not be more than two-thirds full to allow the work and balls sufficient room to move about. The speed of the barrel may vary from 20 to 40 R. P. M. at which speed brass may be burnished in an hour and steel in 2-3 hours. Soft metals such as aluminum require only from .5 to .75 hours.

Dry burnishing with or without balls is usually done on plate coatings and finds its greatest application in the burnishing of nickel plated work or in the burnishing of copper before plating. Dry burnishing with leather scraps with the addition of Vienna line, alumina, rouge, etc. is done on aluminum and zinc to a large degree. The work is burnished at 20-40 R. P. M. from ½ to 2 hours.

Dry burnishing finds its greatest application for work such as screws which must not be abraded. The screws are burnished from 1 to 2 hours in hard fine sawdust using an excess of sawdust so that the screws do not rub together. When fine sawdust is used, it wedges in the threads of the screws and cushions the threads from abrasion.

Hot Tinning Methods

Q.—We have several metal parts which we would like to hot **tin** on a production basis. Could you advise us as to the type of equipment necessary, the general procedure in doing this type of work and any other information that may be of value to us.

A.—Equipment required for the usual small article that is to be hot dip tinned, consists of a cleaning tank, a wash tank, pickling tank and a wash tank, a flux tank and a tin pot. In some cases in tinning various metal parts they are either tumbled or sand-blasted in the cleaning process; the kind and character of the metal part will determine whether these steps are necessary.

The hot dip tinning process consists first in cleaning off any oil, grease or foreign matter from the metal parts by putting them through a good commercial cleaning solution. This solution is kept at a temperature of 180 to 200 deg. F. The tanks can be steel tanks. After passing through the cleaning solution, the parts are then washed thoroughly in clear running water. This removes the alkali of the cleaner and the solution is generally held at about the same temperature.

After cleaning the work must be pickled to remove all scale and iron oxides. If the parts to be tinned are castings, a small quantity of hydrofluoric acid must be used in the pickle to remove all traces of sand or silicious material. The sulphuric acid solution for steel is generally about a 2 to 4% solution in acid strength, and is carried at about 140 deg. F. The acid strength and temperature of the pickle depend entirely upon the character of the scale and iron oxide to be removed. After pickling the parts are washed thoroughly and then put into a liquid flux solution of zinc chloride.

The last step is putting them through the tin bath. They should be allowed to drain thoroughly and then be slowly put into the tin bath which is held at a temperature from 480 to 520 deg. F. depending upon the size of the articles to be tinned and the production put through the bath in a unit time. Tin melts at 450 deg. F. and a little practice will quickly determine which temperature is most suitable to use for the work at hand. The tin bath has a light film of zinc chloride over it and this is skimmed back with a skimmer when the articles are slowly drawn out. They may be placed on a rack if they are very small parts or work that can be conveniently handled in such a manner.

Very small metal parts are cooled in kerosene oil. This bath is surrounded by a water jacket, and the tank usually has a small mesh basket in it that the parts can be emptied into. The basket is then quickly lifted out of the oil, and the parts dried in sawdust, and then the sawdust is sifted out later. With certain kinds of work it is often put in a tumbling barrel with cedar sawdust and given a very light tumbling to dry the work of oil and give a very clean, bright finish.

—Wallace Imhoff.

High Production Methods for Manufacturing Anodized Aluminum Alloy Pistons

Latest Type of Equipment a Feature of Buick's New Machining Line for Anolite Pistons. Interesting Inspection Devices Developed for Quality Control in Production.

ADOPTION of anodized pistons coincident with the introduction of the 1936 models by the Buick Motor Car Company, brought with it the installation at the Buick plant of an entirely new piston machining and inspection line. It incorporates the latest type of production equipment to assure maximum accuracy in manufacture and efficient production.

In addition to the latest type of machine tools, the line is featured by the use of cemented tungsten carbide and diamond cutting tools. A machine on which pistons automatically balance themselves to correct stand weight is another interesting feature.

In production, the pistons are first cut off, head end centered, and open end counterboard for center on an automatic lathe, chucking the piston internally.

Fig. 1. For drilling slot-end holes, milling slots, etc., Buick uses this six station multiple head indexing installation. Not only does the fixture holding table index from station to station, but the individual fixtures also index automatically to permit operations on both sides of the skirt in one set-up

These centers are used throughout the following machining operations for locating.

Rough turning, facing of the head, rough and finish ring grooving, chamfering of the head lands, rough and finish turning of an "expansion" groove in the head land, and chamfering head and skirt end of piston, are all performed in a single set-up on a Fay automatic lathe, with multiple tooling, all tools being tipped with cemented tungsten carbide.

Following this operation, pin holes are rough and finish bored on double head Kingsburys, locating from the head end center. A hand reaming of the pin hole for sizing follows this operation, accurate size control being required for accurate locating as to index in the cam grinders.

Since two oil rings are used in the new Buick pistons, both the lower grooves must be drilled for oil relief. This is done on multiply Kingsburys provided with indexing fixtures. In these fixtures pistons are located by the open end center and the pin hole. The latter is necessary since two of the oil holes in the lower ring groove must match up with oil holes to be drilled through the pin bosses for positive lubrication of the pin bearing in the piston.

The oil holes through the pin boss are next drilled on a two spindle drill and all holes inspected for burrs.

The next operation consists of drilling strain-relief holes at the end of the T-slots in the piston skirt, etc., and milling both the T-slot and the circumferential slot on the pressure side of the skirt. These operations are all performed in one set-up on multiple station Kingsburys with indexing fixtures, six stations being used for these miscellaneous operations.

The pistons go around twice in this installation, the first time for operations on the T-slot side, the second time for operations on the pressure side. Cams in the piston holding fixtures prevent operation of some of the stations—as for milling the vertical skirt slot —when work is being done on the pressure side.

The pistons are now ready for grinding. First, however, the open end bore is re-centered to remove any burrs, etc. for absolute cleanliness in locating on the grinders.

Two grinding operations are provided, rough and finish, with a re-centering of the open end between the two operations. Location for index is from the pin hole. The slotted side of the piston is cam ground .0006 to .001 in higher than the pressure side in these operations to insure proper fit in the cylinder for uniform skirt pressure all around.

Heads are then spot faced on a hand drill. The next operation consists of counterboring all pistons to standard weight. For this operation the pistons are mounted in a floating fixture located on the arms of a weighing scale. The heavier the piston, the more the arms will be depressed of course. The arms and fixture are then locked in whatever position they have reached, the locking hand lever also starting a counterbore cutter feed up into the piston bore. This cutter always cuts to exactly the same height so that the depth of cut taken depends on the position of the piston, vertically, as automatically predetermined by the amount of overweight of the piston.

The cutter then retracts automatically and releases the fixture and piston. The arms re-adjust themselves to a new level so that a direct check is available as to whether the piston has been machined to exact weight, by reading the scale. In actual operation, however, this check is mainly useful as a guide to cutter wear, since the machines are adjusted to consistently bore out the material for each piston.

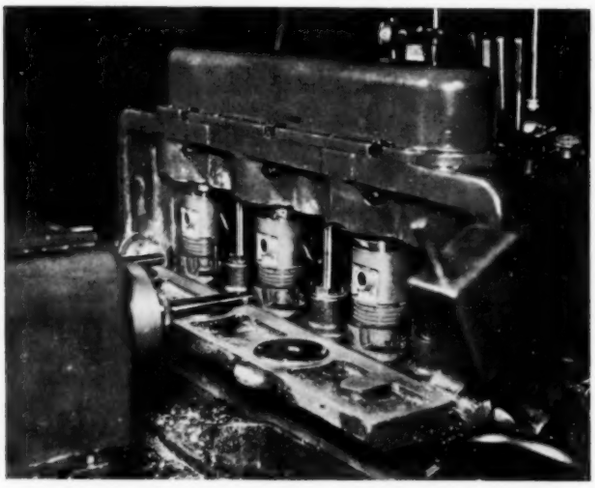


Fig. 2. Detail of one side of the piston pin hole finishing machine. Three pistons are mounted at one time. The pin bores are first finish turned with cemented tungsten carbide tools from the far side and then final finish for maximum accuracy is provided by turning with the diamond tipped tools shown here

Pistons then go to the anodizing installation, where the surface metal is electrolytically changed to a hard oxide, a development which has resulted in tremendously increasing the life of alloy pistons, and one of the main factors making possible the adoption of such pistons by Buick.

Finishing of piston pin holes is reserved until after the anodizing operations. This is done on double head horizontal borers, several of these being grouped as one machine and simultaneously operated. Pistons are mounted in the center and semi-finish boring tools tipped with cemented tungsten carbide are run through the pin holes. These then retract and the diamond point borers on the opposite side feed through the pin hole for final finish.

Final inspection of pistons is carried on in an air-conditioned constant-temperature room to remove any variations due to temperature changes from day to day in the shop. A number of interesting inspection fixtures have been worked out for final checking.

On one of these fixtures, equipped with multiple arms and four gages, pistons are checked for alignment of pin hole, etc., for over-all length and for correct height of hole from piston head.

Another inspection fixture equipped with two gages checks piston ring grooves for eccentricity, width, and depth.

Inspection of pistons for OD and width across the cam ground faces, etc. is done on a special fixture provided with mirror amplifiers, throwing a shadow of the pointer against an enlarged dial.

For assembly, pistons by this means are grouped in eight sizes, in steps of .0003 in. of OD. A number corresponding to the size of the piston is immediately stamped on a pin boss of the piston.

Palladium Leaf on Vulcanite

Q.—We have a shop problem of laying palladium leaf on vulcanite, the surface of which is under constant moisture. What is the best bonding substance you can recommend?

A.—Your question is not perfectly clear. Do you mean that the vulcanite is wet at the time you are trying to apply the palladium leaf? If so, we have no suggestions to make. But perhaps you mean that the surface is to be exposed to constant moisture after the palladium is applied. In that case, you would presumably apply the palladium leaf to the dry vulcanite surface, using heat and pressure, the same as in the application of gold leaf to fountain pens or combs. Your problem then would be to keep the thin leaf from being worn off, while under constant moisture.

Palladium leaf is extremely thin, of the same order of thinness as gold leaf. Also it is rather soft. If laid on a surface that has any roughnesses or irregularities, the thin layer would be broken in many places and the underneath surface exposed. If there is any friction against the surface, the palladium will soon be worn off. Even on a perfectly smooth surface, the soft metal cannot be expected to resist wear indefinitely.

In your case, we suggest that you write much more fully, telling whether the material will be subjected to friction or not, the temperatures involved, whether the moisture you speak of is pure water, steam, or what not; and so on.—**Jewelry Metallurgist.**

Corrosion of Solder

Q.—We wish to ask concerning the effect of refrigerants, such as sodium chloride, on solders used in the pipe lines in refrigerating plants. The solder consists of the usual 50-50 mixture.

Have you any data or can you give me any references on this subject?

A.—Brine solutions such as sodium chloride or calcium chloride, free from magnesium chloride, can be satisfactorily used in lead pipes with soldered joints. When such brines are used in copper containers which are soldered, there is danger of galvanic action when both metals are exposed to the brine. As a result of the galvanic action, the solder may be badly corroded.

If the brine is to be used in a copper tank the seams may be double locked with the application of solder on the outside, so that it does not come in contact with the brine.

You may be interested in the following references:

Refrigeration and Refrigerants Industrial and Engineering Chemistry; Vol. 24, 1932, p. 601.

Research No. 3 by British Non-Ferrous Metals Research Assoc., The Jointing of Metals—Part 1—Soft Solders and Soldered Joints.

Solder is not corroded by the refrigerants: Freon, methyl chloride and sulphur dioxide, even when the solder is in contact with copper or other metal. No galvanic action occurs as long as the refrigerant is anhydrous, which is ordinarily the case.—**G. B. H., Jr.**

Editorial Comment

Metals in the New Transportation

ONE of the outstanding features of the excellent winter meetings of the Institute of Metals Division (reported on pages 87-93 of this issue) was the Symposium on Metals in the New Transportation. Obviously here is a vastly enlarged market for metals in an old industry which is reviving, (at least mentally) in unmistakable fashion. The railroads are awake as never before to the need for making their services attractive.

The question of the quantities of metals which they will absorb in the new high speed trains is clouded, however, by the straitened financial conditions of the railroads. The railroads are still poor. They need more business and they know that it is necessary to spend money to get it. But every dollar spent is scrutinized keenly before being permitted to get away. They want the best possible trains to win back traffic from buses and motor trucks, but they will be of the cheapest materials which will give them adequate service. Wherever they use expensive alloy steels and non-ferrous metals, they do so because nothing else will be satisfactory or pay so well.

Incidentally a pretty battle is in progress between aluminum alloys and stainless steel alloys for this business.

No discussion of metals in transportation would be complete without reference to Dr. Mathewson's paper on the heavy metals, copper, zinc, tin, lead, etc., and their alloys, which was one of the high spots of the Symposium. These metals are humble aids in the construction of transportation equipment of all kinds, railroad, automotive, marine and even aircraft. They are used in comparatively small quantities per unit (except for locomotives) but they are indispensable We commend this paper to the attention of our readers. We also commend the railroads as a source of increased business for metal and alloy producers in the future. They will not always be poor.

Alloy Deposition

ONE of the marked trends in the electroplating industry during the past few years, has been the greatly increased interest in the deposition of alloys. Of course, in principle, this is nothing new; brass has been plated for decades. But the possibility of new finishes with improved appearance and improved properties is vastly increased by wide variety of materials, and mixtures such as alloys afford.

Space does not permit the listing of all the work done in this field within recent years, but a new example cannot be permitted to pass by unnoticed. At the recent meeting of the American Mining and Metallurgical Engineers, held in New York in February, a paper was read on Electrolytic Solder by R. P. Hermsdorf and Max Heberlein, which described the manufacture of high purity solder from tin-lead fluosilicate solutions. The output is a commercial product being sold to the trade for all purposes for which solder is used.

It seems entirely possible that the coming expansion in electroplating will lie along the lines of alloy deposition.

Cadmium—Industrial or Jewelry Metal?

SEVERAL months ago cadmium started on its ride up the hill, from 55 cents per pound to well over a dollar. This run-up, as everyone knows, was caused by the conversion of some automobile manufacturers to the use of cadmium in bearings. No doubt, the reasons were adequate.

Unfortunately, however, one point was overlooked, namely the fact that cadmium is not a primary raw material but a by-product; that its production is limited largely by the production of zinc, and that it is not economic to increase the production of zinc sufficiently to keep the price of cadmium within bounds. Consequently, cadmium headed for the sky and is still in the rarified regions.

Cadmium plating was the first to suffer and the industry took the natural step, which was developing a substitute. In a very short time several bright zinc solutions appeared on the market which bid fair in time to work out to the complete satisfaction of the users.

In the meantime the automobile manufacturers are undoubtedly becoming restive. They can hardly enjoy paying a dollar a pound for a bearing material. How near they are to the end of their patience we have been unable to determine. Inquiries addressed to the larger users of cadmium for bearings has elicited nothing but polite refusals to commit themselves.

It is our guess that cadmium is very near to the price at which it will become uneconomical for the automobile manufacturer to use this metal for bearings. We feel also that when and as they turn to substitutes, cadmium will find itself in a much worse position than it was before the boom.

The Business Trend

THE record of business during the last few weeks has been on the whole, not discouraging. Industrial production has continued at about the same index level, and while output has been lower, this is normally a quiet season. Also business has been retarded by the unusually severe weather. Competent observers note that business seems to have developed some immunity to the threats of political interference, and that it is set to go ahead almost regardless of Washington. The AAA has been declared unconstitutional but agricultural prices are still holding well. The explanations of this fact vary with the political beliefs of the explainer. The TVA, has been declared constitutional and while there has been some talk of reduced buying by the public utilities on this account, the copper market, one of our foremost materials for utilities, is decidedly strong. The Stock Exchange has been advancing steadily—perhaps too steadily.

It seems to be the feeling also that there is no immediate prospect of currency inflation as the Administration is definitely set against such a move. There is a trend toward credit inflation which may be felt within the next one to three years. However, the immediate prospect is for careful steps, especially in view of the coming Presidential election.

New Books

Chromium Plating with Special Reference to Its Use in the Automobile Industry, by Prof. Dr. Ing. E. H. O. Bauer, Professor H. Arndt and Dr. Ing. W. Krause. Translation from the German by E. W. Parker. Published by Edward Arnold and Company, London, England. Size 6 x 9, 266 pages. Price $9.50.

The data assembled in this book is from the report of an investigation carried out, under the German Government sanction in collaboration with the State Association of the Automobile Industry. This investigation was carried out with the commendable object of "securing data of a reliable and unbiased character which could be placed at the disposal of industry with a view to raising the general standard of commercial plating."

About one hundred samples of commercial plating on automobile parts were obtained, some from America and France, the largest number from Germany. Not only were these examined but for comparative data a large number of automobile parts were plated in solutions that were correctly constructed and maintained under strictly controlled conditions such as used in commercial plants.

The program planned and carried out was comprehensive and indicates the careful study made of the assigned problems.

1. Composition, thickness and regularity of coating.
2. Surface condition (colors, lustre, surface defects).
3. Adhesion and capacity for deformation.
4. Hardness and resistance to wear.
5. Resistance to changes of temperature.
6. Resistance to corrosion ((a) by determination of porosity, (b) by measurement of potential and (c) by corrosion tests).

The translator has conveyed all the detail of thoughts that was in the minds of the investigators. The work is excellently done.

There is an introductory chapter by A. W. Hothersall M.Sc. the well known English investigator whose work at Woolwich stands by itself in the electroplating field.

The writer of this review is impelled to state that a better review of this book than what is included in the Introduction could not be written. The privilege of quoting liberally is taken without apologies for omitting identifying marks. The whole text should be read and studied.

The authors spared no effort to make this work complete and where no reliable method was available, attempts were made to devise one. All published methods of testing the characteristics of electrodeposited coatings were critically examined and a value established.

They found relatively little information on the effect of the conditions of deposition or of the properties of the underlying metal on wear resistance and they therefore investigated this important phase of cause and effect and accomplished a most thorough job. They determined that the final criterion of a nickel coating as an underlying coat for a chromium deposit was the porosity of the nickel deposit and therefore a reliable porosity test is the basis on which inspection tests can be formulated.

The authors discuss the forces tending to cause detachment of the coating under the head of stress in the deposit, dimensional changes in the basis metal, differences in thermal expansion and stresses produced by external forces which cause deformation.

There are several tables giving the data assembled about atmospheric exposure tests, porosity tests, ball indentation, close-bend and adhesion, with a final summary of corrosion tests on the experimental samples.

The illustrations are of the highest quality in care of producing and reproducing in print, (the publishers used unusual care with the plates and in the selection of paper). There are 193 photographs, 30 of which illustrate corrosion, the final test for electroplated coatings.

At the end of the book is a most complete bibliography from 1903 to 1935, given in the unique manner of placing each paper in the year it was published. There are 582 references all clearly indicated throughout the text. The translator materially contributed to the value of this bibliography by providing a fuller survey of English, American and Continental work on the electrodeposition of nickel and chromium.

Hothersall states, "advances are fostered by periodically collecting the results of research and correlating them with commercial practice." This function has been fulfilled in this book by the description of an examination of the properties of nickel and chromium coatings, as produced commercially, by the discussion of the results, and by the provision of a very extensive but selective bibliography.

The admirable conclusion is "This book fulfills a useful purpose in providing a correlation between the results of research and practice."

This book is a most valuable contribution to the electroplating literature. It is a treatise that increases knowledge and opens up vast vistas for investigators, gives practical methods to the electroplater and furnishes reliable data for the engineer and the manufacturer. It is a practical technical book.

—George B. Hogaboom.

Journal of the Institute of Metals (British), Volume 57, (Proceedings) No. 2, 1935. Size 5 x 8, 311 pages. Price L 1, 11s., 6d. Published by the Institute of Metals, 36 Victoria Street, Westminster, S. W. 1, London, England.

This volume includes the papers read and the discussions at the autumn meeting of 1935. These papers were published in abstract in **Metal Industry** for October, 1935.

International Repertory of Centres of Chemical Documentation. Published by the International Office of Chemistry, 28 Rue St. Dominique, Paris, France. Size 8½ x 12; 115 pages. A set of centres of bibliography and documentation, abstracting of chemical literature.

Standards on Rubber Products. Published by the American Society for Testing Materials. Size 6 x 9, 204 pages. Price $1.25. This book, sponsored by Committee D-11 of the A.S.T.M. was compiled as a laboratory standard manual; gives methods of testing and specifications.

Journal of the Institute of Metals for 1935. Volume 51. Published by the Institute of Metals, London, England. Size 5½ x 8½; 306 pages. Price £1, 11s, 6d plus postage. A complete record of the two most recent meetings with the papers presented and discussions. Abstracts of these papers appeared in **Metal Industry** for April and October, 1935.

Metallurgical Abstracts. Published by the Institute of Metals, London, England. Size 5½ x 8½; 780 pages. Price £4 including two volumes of Proceedings. Issued as a supplement to the Monthly Journal of the Institute of Metals. Abstracts have been gleaned from over 1,000 of the world's scientific and technical publications. The subjects covered range from properties of metals to industrial uses and applications.

Proceedings of the A.S.T.M. 38th annual meeting, held in 1935. Published in two volumes. Part 1, Committee Reports and Tentative Standards; Part 2, Technical Papers. Size 6 x 9, volume 1, 1,488 pages; volume 2, 769 pages. Price $5.50 to $7 per volume depending upon binding.

These proceedings include sections on non-ferrous metals covering reports on copper wire, non-ferrous metals and alloys, corrosion of non-ferrous metals and alloys, electrical heating, electrical resistance and electric furnace alloys, copper and copper alloys, cast and wrought, and die cast metals and alloys. Abstracts of the reports and papers on non-ferrous metals were published in **Metal Industry** for April and July, 1935.

Shop Problems

This Department Will Answer Questions Relating to Shop Practice.

METALLURGICAL, FOUNDRY, ROLLING MILL, MECHANICAL, ELECTRO-PLATING, POLISHING, AND METAL FINISHING

ASSOCIATE EDITORS

H. M. ST. JOHN W. J. PETTIS W. J. REARDON W. B. FRANCIS
G. BYRON HOGABOOM T. H. CHAMBERLAIN WALTER FRAINE

Bluing Stoves

Q.—We are desirous of bluing the cast tops on our coal and wood ranges similar to what other manufacturers do and we are writing you for information relative to the procedure used to obtain this blue color.

A.—There are several methods that can be used to obtain a blue finish on parts mentioned provided that they have a good finish and are free from grease and oil. The most satisfactory blue on iron is obtained by heating to 550 deg. F. to 650 deg. F. Higher temperatures tend to produce gray colored work. A continuous sand tempering machine may be used for producing such a finish on large parts. The work is carried through a perforated drum and heated sand is automatically sifted into the drum. Adjustments of the temperature and rate of feed may be made so that a continuous stream of work having a uniform color is secured.

Heat coloring may be done in a retort of proper size without sand. It is, however, necessary to have the temperature accurately controlled and that sufficient time be allowed for the oxidation of the iron to take place.

Parts that are blued should be coated with a thin film of oil.

—T. H. C., Problem 5,470.

Chemical Black on Cast Iron

Q.—We manufacture coal and combination coal and gas ranges with cast iron tops. These tops are polished on carborundum wheels after assembly and the manufacturers then want to finish the tops with a smooth black surface. This finish up to the present time has been produced only by heat treatment in an enamel furnace.

We are advised that there is some way of producing a smooth black finish that is quite durable without the necessity for a heat treatment. If you have any information in this connection or can refer me to someone who may be able to help me, I shall be deeply grateful.

A.—It is possible to produce a black finish on cast iron that has been polished and free from oil and grease by applying the following mixture:

Copper sulphate	8 pts. by wt.
Nitric acid	15 pts. by wt.
Alcohol (ethyl)	30 pts. by wt.
Water	125 pts. by wt.

Allow this solution to dry on work and when quite dry rub with woolen cloth. A thin film of oil should be applied for final protection.

—T. H. C., Problem 5,471

Cold Gold Solution

Q.—Kindly let me know as soon as possible what to do with my gold solution. I have a 3 gallon bright gold solution made with the porous cup, 6 ounces C.P. Cyanide; 6 Pennyweight of fine 24K gold and 2 ounces of carbonate of soda to the gallon, and boil the mixture for a few minutes. I use a 10 or 12 pennyweight gold anode. I use my solution cold. My solution does not work as fast and the color is not so bright as when first made.

I believe I have carried lots of water with my work into the solution. Would you kindly let me know if I can run more gold in my solution the same way by the porous cup. Or could you give me a better formula for a bright cold solution that does not require heating to do plating. I want a solution that I can use cold.

A.—To obtain satisfactory results from a gold cyanide solution it is essential that the temperature should be at least 130 deg. F.

It is possible to run such a solution at ordinary temperature but not practical for uniform, bright deposits. The solution should be kept free from foreign matter as much as possible. Frequent filtration is recommended. Additional gold can be dissolved in present solution by the porous cup provided that sufficient free cyanide is present; however, this is not recommended as good practice. A stock solution of known gold and cyanide content made by the porous cup method should be used for making additions to solution.

USE THIS BLANK FOR SOLUTION ANALYSIS INFORMATION

Fill in all items if possible.

Date.....

Name ..... **Class of work being plated:** .....

Address ..... **Volume used:** .....

Employed by: ..... **Solution depth:** .....

Kind of solution: ..... **Cathode surface, sq. ft.:** .....

Tank length: ..... **width:** ..... **Kind of anodes:** .....

Anode surface, sq. ft.: ..... **Distance from cathode** ..... **Original formula of solution:** .....

REMARKS: Describe trouble completely. Give cleaning methods employed. Send small sample of work showing defect if possible.

Use separate sheet if necessary. _____

NOTE: Before taking sample of solution, bring it to proper operating level with water; stir thoroughly; take sample in 2 or 3 oz. clean bottle; label bottle with name of solution and name of sender. PACK IT PROPERLY and mail to METAL INDUSTRY, 116 John Street, New York City.

The following solution will produce satisfactory bright gold deposits:

Sodium gold cyanide	½ oz./gal.
Sodium cyanide	1 oz./gal.
Sodium phosphate	3 oz./gal.
Water	1 gal.
Temperature	130-150 deg. F.
Voltage	2½-3

This solution is made by using water soluble sodium gold cyanide. The use of the porous cup is not required. The solution can be used cold but cannot guarantee results.

—T. H. C., Problem 5,472.

Etching Copper or Zinc

Q.—Could you suggest a non-acid solution to be used in etching copper or zinc plates and which does not affect the bichromated ground?

A.—A neutral solution of Perchloride of Iron, 36 deg. Be to 40 deg. Be can be used for etching copper plates without affecting the bichromated ground. No non-acid solution for etching zinc plates is known that will give results desired.

—T. H. C., Problem 5,473.

Fine Dull Matte Finish

Q.—I am enclosing a watch dial which I have finished per your instructions, August issue. I like this finish very much and wish to thank you for the information.

I am enclosing a sample of the powder used which is 1½ oz. silver powder, 1 oz. cream tartar, ½ oz. salt ground dry. I desire to produce, in order to duplicate, a whiter powder finish as you notice this sample has a metallic appearance.

A.—The mixture submitted should produce a fine dull white mat finish if properly applied. However, it is suggested that the following mixture be tried:

Precipitated silver	1 pt. by wt.
Cream of tartar	2 pts. by wt.
Salt (dry)	2 pts. by wt.

Moisten with enough water to make a paste and apply with a stiff brush. The color may be whitened by electroplating for several minutes in a regular silver bath.

—T. H. C., Problem 5,474.

Finishing Steel Handbag Chains

Q.—We are interested in obtaining a formula for brass, nickel or tin plating steel chains used on handbags.

We understand that work of this type may be plated in a barrel, but since we have no previous experience either with plating of steel or barrel plating, we would appreciate it very much if you would give us some information regarding these matters in one of your future issues.

The chains are of the type being used for jewelry and kindred purposes.

A.—To remove oil from steel chains prior to electroplating it is suggested that they be vapor degreased and then electro-cleaned at 12 volts in a alkali cleaner. The work should be placed in a suitable wire mesh container (copper or brass preferred). Cleaning tank should be equipped with a double pole double throw switch with a capacity of at least 200 amperes so that polarity may be reversed. Making the work both the anode and cathode will give best results.

It is also practical to roll chains in a soap solution to remove oil and brighten. After rolling, electrolytic cleaning should be followed as above. After electro-cleaning work should be rinsed well in clean running water, pickled in 20% sodium cyanide solution, rinsed in water and placed in plating barrel.

The following solutions can be used for brass, nickel and tin barrel plating:

1. **Brass Solution:**

Sodium cyanide	11 oz.
Copper cyanide	8 oz.
Zinc cyanide	2 oz.
Soda ash	4 oz.
Water	1 gal.
Temperature	75-90 deg. F.
Current density	3-20 amp./sq. ft.
Voltage	5-10 volts
Anodes, annealed copper 80%—zinc 20%	

The addition of ½ oz. per gallon of ammonium hydroxide will aid in producing a yellow deposit. A brass deposit can be applied directly to steel chain. Time of plating at least 1 hour. Chain should be ball burnished for high lustre. To protect from tarnish brass lacquer should be used.

2. **Nickel Solution:**

Nickel ammonium sulphate	8.00 oz.
Nickel sulphate	8.00 oz.
Nickel chloride	4.00 oz.
Boric acid	2.00 oz.
Water	1 gal.
pH	5.8-6.0
Temperature	20 deg. F.
Current density	20-25 amp./sq. ft.
Anodes, rolled anneal depolarized, 99%	

Nickel may be deposited directly on steel. Ball burnished after plating to obtain high lustre.

Time of plating ¾ to 1 hour.

3. **Tin Solution:**

Sodium stannate	24 oz.
Sodium acetate	4 oz.
Powdered rosin	3 oz./per 100 gal.
Water	1 gal.
Temperature	130 deg. F.
Current density	12 amp./sq. ft.
Anodes, Straits tin or other anodes of equal parity.	

It is advisable to add small amounts daily of 100 volume hydrogen peroxide to oxidize stannite salts formed back to the stannate condition. This will prevent the building up of stannite salts. The panels of the cylinder used in the barrel must either be canvas or hard rubber with perforations. After plating parts are to be tumbled in an open end oblique wood barrel using a neutral soap solution until lustre is obtained. Rolling time should not be over 10 minutes. After rolling in soap solution parts are rinsed in cold water and then rolled in cold hardwood sawdust in similar type barrel mentioned. After drying in sawdust the parts are riddled to separate sawdust.

—T. H. C., Problem 5,475.

Pitted Copper

Q.—We are sending in the attached bag 3 sample hinges; 2 of these samples have been copper plated and buffed and you will note upon examination that the plated surface shows small pits. We would like to know what causes this. These parts were plated in hot cyanide copper solution and plated slowly so as not to burn, which the one sample will indicate, taken from the same load as the other two samples.

The solution was filtered, we thinking that this trouble was caused by a dirty solution, but the work was pitted the same after filtering. We have carefully checked the cyanide and metal content of our solution and find everything to be OK.

A.—Pitting such as shown on samples can be caused by the use of too high a current density, lack of proper agitation of work in solution or high concentration of carbonates. The plating of heavy deposits of copper from a warm cyanide solution it is essential to agitate the work.

Excessively high current densities should not be used as they will cause abnormal gas evolution of the cathode resulting in pitting even though work is agitated. At the same time the temperature of the bath should not exceed 120 deg. F. and the free cyanide should not be over 1.00 to 1.25 oz. per gal.

High concentration of carbonates will cause pitting and should be removed if they are in excess of 7 to 8 oz. per gallon. Removal can be best accomplished by lowering temperature to precipitate carbonates.

—T. H. C., Problem 5,476.

Silver Polish

Q.—We have been asked by a customer for a formula for making a paste or cream for cleaning silver plate without scratching. Can you help us?

A.—An excellent silver polish may be obtained by mixing the following ingredients:

A good grade of white soap finely shaved, 80 parts; levigated chalk, 18 parts; jewelers rouge, finest levigated, 2 parts; hyposulphite of soda, 2 parts. Dissolve soap in smallest possible quantity of hot water, then incorporate other ingredients, thoroughly mixing to obtain a thick paste. A few drops of an essential oil such as sassafras will give a pleasant odor to polish.

—T. H. C., Problem 5,477.

Practical Brass Foundry Digest

By H. M. ST. JOHN

Chief Metallurgist, Detroit Lubricator Company; Associate Editor, Metal Industry.

Short Abstracts of Articles of Interest to Practical Non-Ferrous Foundrymen and Metallurgists.

Rocking Arc vs. Crucible Furnaces

To the Editor of **Metal Industry**:

The January issue carries a review of current literature entitled "Practical Brass Foundry Digest." We believe the review of the article in November 8th issue of the Metal Industry (London) by Francis W. Rowe, entitled "The Production and Control of Bronze Castings" might be misleading. The reviewer says, in regard to the melting equipment:

"Both crucible and reverberatory furnaces do excellent work but are likely to produce gassed metal if not properly controlled. R. thinks the electric furnace capable of producing the highest physical properties obtainable with bronze alloys and describes the rocking arc-type furnace used in his experiments."

Mr. Rowe's paper is thus correctly reported. However, in the discussion, Dr. N. P. Allen said:

"Mr. Rowe evidently thought a bronze should be melted in a slightly oxidizing atmosphere but electric furnaces (arc-type) would give a reducing atmosphere. He had done some experiments in analyzing the atmosphere inside the furnace, and it consisted of nitrogen and carbon monoxide, the latter as much as 50%, which was more than the theoretical amount. There was also about 2% hydrogen. The atmosphere was strongly reducing. Mr. Rowe had said that hydrogen was one of the gases responsible for the gassing of bronze and it seemed there was some possibility of this causing unsoundness. He felt they never knew what was the cause of unsoundness in bronze castings and it seemed to him that the reducing atmosphere of the electric furnace may be the cause. He would like to ask Mr. Rowe to state if he worked with a reducing or oxidizing atmosphere."

Mr. Rowe, in reply said:

"Melting in a slightly oxidizing atmosphere appeared to be better than melting in a reducing atmosphere. He did not like to be definite on that point, but there were one or two things that founders did that corroborated the point."

In view of the contradictions in Mr. Rowe's statements as brought out by Dr. Allen, we believe the impression gathered by those actually in attendance at the meeting, or those reading Dr. Allen's discussion as well as Mr. Rowe's paper, was not so conclusively in favor of the rocking arc-type furnace as the brief review given in the January issue of the publication, would indicate.

VESUVIUS CRUCIBLE COMPANY

Richard H. Stone

I have noted Mr. Stone's comments on our abstract of Mr. Rowe's article and have carefully re-read both the original article and the discussion which followed it, as reported in Metal Industry (London). As I understand Mr. Stone's objection, the abstract, while it correctly presents the substance of Mr. Rowe's paper does not adequately cover the following discussion which, it is thought, tends to modify or qualify some of Mr. Rowe's statements.

It must be remembered, first of all, that it is difficult to abstract a reporter's account of a technical discussion. In attempting to do so we have to deal, not with the actual statements made by the various speakers but with a reporter's condensation of remarks delivered verbally, from which the reporter reproduces, as well as he can, the substance of what was said. Apparent contradictions, which the abstracter cannot hope to reconcile in the space at his disposal, are bound to occur.

If we consider Mr. Rowe's original paper and the reporter's account of his portion of the discussion, we find his views to be as follows: A slightly oxidizing atmosphere is to be preferred in the melting of bronze. This opinion is specifically limited to crucible and reverberatory furnaces since, for some reason not known, the electric furnace seems to be free from the difficulties encountered when an open-flame oil furnace is operated with a purposely-reducing, smoky flame. The electric furnace, when operated in a normal manner (whatever the atmosphere may have been) did not yield unsound castings.

Obviously this leaves Dr. Allen's question unanswered and Mr. Rowe was perfectly willing to admit, by inference, that his experience did not give him a sufficient basis for a specific answer. So much for the abstract, which was intended only to represent the original author's views with no further qualification except such as might be indicated by his own part in the ensuing discussion.

Carbon monoxide appears to have no reducing action on molten brass or bronze, although it is strongly reducing with pure copper. The atmosphere of an electric arc furnace, which normally consists of nitrogen and carbon monoxide, is therefore neutral rather than reducing. Hydrogen and the lighter hydrocarbons, such as methane, are strongly reducing. If the metal charged into the electric furnace contains water, hydrogen will be found in its atmosphere and, if the quantity of hydrogen is sufficient, the resulting castings will be unsound. If the charge contains oil, hydrogen and gaseous hydrocarbons will be present in the furnace atmosphere and the castings will be unsound. If the arc furnace is operated at a subnormal voltage so that a smoky, hissing arc is obtained the furnace atmosphere will be filled with soot from the graphite electrodes and the castings will be unsound.

In other words, hydrogen, such gases as methane, and finely divided carbon, are all injurious to brass and bronze, no matter what type of furnace is used. So far we can all agree. Carbon monoxide, in the present writer's opinion, is harmless, and an atmosphere containing substantially nothing but nitrogen and carbon monoxide avoids the disadvantages of both oxidizing and reducing atmosphere. A slightly oxidizing atmosphere is better than a reducing one but a neutral atmosphere is better than either, unless of course you are trying to burn out aluminum or some other oxidizable impurity.

The above seems to agree well enough with Mr. Rowe's results and might answer Dr. Allen's question.

H. M. St. John.

Equipment

New and Useful Devices, Metals, Machinery and Supplies.

American Wheelabrator Multi-Rotary Table

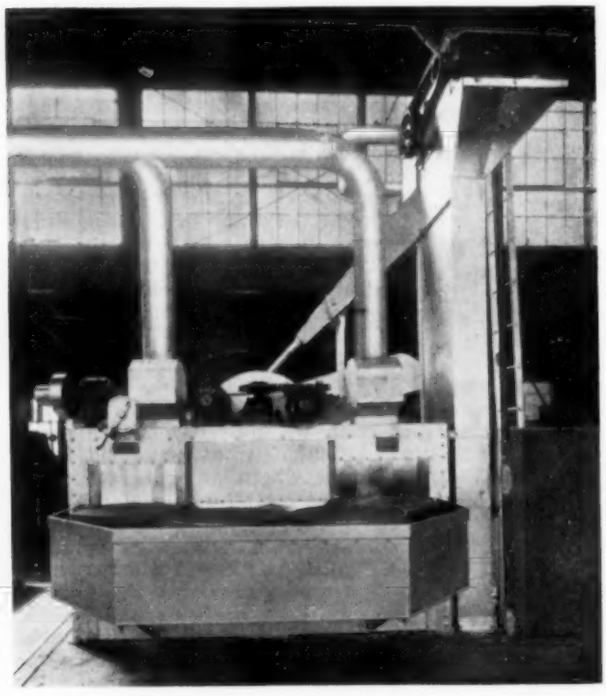
The American Wheelabrator Multi-Rotary Table has just been announced by the American Foundry Equipment Company, 408 Byrkit Street, Mishawaka, Indiana.

The Wheelabrator Multi-Rotary Table consists of a number of independent tables (the number and diameter of tables can be varied). A guide under the center of each table runs in a track, which, directly under the Wheelabrator runs in a straight line for about 6 ft. This directs the tables under the Wheelabrator blast, so that the work will obtain the full effective blasting range of the abrasive as it leaves the wheel. The flat vertical side of the table contacts a moving belt revolving the tables as they pass under the blast. The speed of this belt is variable so that the speed of turning the tables can be varied as well as the speed of their travel under the Wheelabrator. After traveling under the Wheelabrator blast, the tables follow the track out of the cabinet where the material can be removed or turned over for a second application under the Wheelabrator.

Certain types of castings, forgings or stamped metal parts are cleaned more satisfactorily on a table type abrading machine than in the tumbling type. Fragile pieces or parts which would be scratched or injured in the tumbling process fall into this class.

The American Wheelabrator Multi-Rotary Table is said to operate at 1/5 to 1/10 the cost of operating air equipment and the result is a uniformly cleaned surface. It is claimed that there is no streakedness and vertical sides of any parts up to 5" high are perfectly cleaned.

Cycle of operation of the Wheelabrator with the Multi-Rotary Table consists of an abrasive load in an overhead hopper. From the hopper the abrasive is fed, via a chute and control gate, to the center of the patented wheel. By centrifugal force the abrasive is thrown from the blades of the wheel onto the work to be cleaned or prepared. The abrasive is controlled as to volume and direction of blast so that any type of cleaning and preparation can be accomplished, from light metal parts requiring a satin finish



Wheelabrator Multi-Rotary Table

Latest Products

Each month the new products or services announced by companies in the metal and finishing equipment, supply and allied lines will be given brief mention here. More extended notices may appear later on any or all of these. In the meantime, complete data can be obtained from the companies mentioned.

Professional Model Drafting Machine; a complete unit with a 22" x 30" cleated, white pine board. L. G. Wright, Inc., 5713 Euclid Avenue, Cleveland, Ohio.

New Electrode for Welding Bronze, Brass and Copper. Lincoln Electric Company, Cleveland, Ohio.

New Mercury Vapor Lamp. 250 watt high intensity design. Westinghouse Electric & Manufacturing Company, E. Pittsburgh, Pa.

Welding Positioner; to handle pieces up to 4 tons. Harnischfeger Corporation, Milwaukee, Wis.

New Hydraulic Press; with self-contained hydraulic power unit using oil as the fluid medium. Farrel-Birmingham Company, Inc., Ansonia, Conn.

Lewis Striper. Designed to lay a perfect stripe in less than one-third the time required by hand. Lewis Manufacturing Company, Decatur, Ill.

Splash-Proof, Squirrel-Cage Motors; in all ratings from ½ to 200 h.p. for constant and multi-speed, continuous or intermittent duty in all voltages and cycles, for any torque and starting current.

to heavy castings or forgings needing dirt or scale removed. Use of selected sizes and types of abrasive regulate the cleaning or preparation selection.

Spent abrasive, after being thrown from the wheel onto the parts to be cleaned, falls into a hopper, which feeds to a screw conveyor. The screw conveyor delivers abrasive into an elevator boot and via a bucket elevator is taken to the overhead hopper for reuse through a continuance of the cycle.

Illustrated folder, No. 33, describing the American Wheelabrator Multi-Rotary Table will be sent to any one writing the company for it.

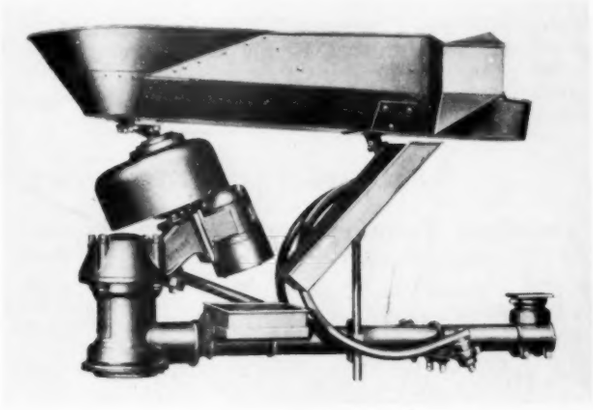
Gyratory Screen Unit for Sandslingers

The Beardsley & Piper Company, 2541 N. Keeler Avenue, Chicago, offers a new gyratory screening unit for Tractor, Stationary, Portable, and Motive Junior type **Sandslingers,** made before 1935. (It is standard equipment on later models.)

This new unit is readily interchangeable with the reciprocating screen units with which these machines were originally equipped.

The new Beardsley & Piper gyratory screen unit, it is stated, requires a minimum of power, has fewer operating parts, nothing to rapidly wear or break, and accordingly reduces maintenance time and cost on this part of the machine.

Because this new unit is more accurately balanced and also because of the unique screening action which is both circular and forward and backward,



Gyratory Screening Unit

The manufacturer claims the use of these new screen units will greatly improve sand conditions by better screening and conveying, offering as well greater sand capacity per sand square foot of screen area, and much quieter and vibrationless operation.

Sandslinger operators on units employing this new mechanism claim a decided improvement in work as well as increased production.

A bulletin describing this new device is available to **Sandslinger** users from the manufacturer.

Optical Pyrometer

The Pyrometer Instrument Company, 109 Lafayette Street, New York, are manufacturers of the Pyro Optical Pyrometer. This is a totally self-contained, direct reading precision instrument; there are no correction charts or curves to consult, no accessories, no upkeep. Its compactness and ease of operation it is claimed, enable the operator, by means of a new concentrated test mark, to measure quickly (2 seconds) and accurately the temperature of minute spots, fast moving objects or of the smallest streams. A master lamp, aside from two service lamps, is furnished with each instrument for the purpose of self-recalibration.

Pyro can be furnished with various scale ranges to meet all plant and laboratory requirements.

Pyro Optical Pyrometer

Abrasive Cut-off Machine

The illustration below shows a new development in abrasive cutting—the Tabor Brasive Cutoff Machine, made by The Tabor Manufacturing Company, 6225 Tacony Street, Philadelphia, Pa.

The machine is rigidly constructed, with the head carried by a substantially proportioned base that prevents vibration. The spindle is mounted in heavy-duty, anti-friction, dust-proof Timken bearings. A multiple belt drive is used and wheels and belt are guarded for the

"Brasive" Cutoff Machine

protection of the operator. The table is easily adjusted for height, and is made in halves which may be adjusted to accommodate odd shapes.

The machine is made in four types:

With a stationary head with which the work is placed on the table and fed into the wheel by hand.

With a combination stationary and chopping head. This permits of the use of the machine as described in the above paragraph by simply locking the head in the stationary position. Releasing the head permits raising the cutting wheel to bring it down on the work when used on jobs that require such a cut because of the shape of the piece, or size of cut making it advisable to clamp the work.

With a traversing head which is brought forward into the work, permitting the work to be securely clamped in position.

With a travelling table carrying the work suitably clamped, to permit of long cuts.

The Tabor Brasive Cutoff Machine is said to be adapted for use not only in the cutting of gates and risers from castings, but also for the cutting of brick, bar stock, strip steel, tubing, etc.

Metallic Lacquers

A new line of metallic lacquers has recently been announced by The Stanley Chemical Company of East Berlin, Conn.

These lacquers are offered in 26 standard shades and provide a wide range of colorful, smooth, lustrous finishes. All of these colors except five contain no dye or bleeding pigments thus insur-

ing maximum resistance to fading. This permits top coating with a clear lacquer when desired. The formulation of these materials practically eliminates the settling of the metal powders. It is claimed that normal stirring before use will produce a uniform color and metallic effect.

These lacquers are designed for spray application to steel, brass, aluminum, and other metals. It is stated that manufacturers will find them extremely economical as they can be reduced considerably, and will produce a film of excellent adhesion, hardness, and durability.

The Jetal Process

Developed by the Alrose Chemical Company, 80 Clifford Street, Providence, R. I., and sold and serviced exclusively by the Hanson-Van Winkle-Munning Company of Matawan, N. J., the Jetal Process is a chemical process for coloring all grades of iron and steel a uniform, brilliant jet black.

This process is intended for iron and steel objects which include strip, sheet forgings, tempered steel and malleable castings.

The objects are prepared for treatment by degreasing in any convenient manner, rinsing in water, pickling to remove heavy scale or rust and rinsing again. Immersion in the Jetal bath for the required time, about five minutes, will furnish a thin black finish, adherent enough to bend without destroying its appearance. Highly polished pieces will have a dull black finish.

Outstanding features claimed for the Jetal Process are: low working temperature; a simple solution easily maintained; quick, certain action and low cost. Ordinary steel tanks may be used for the solution and work can be handled in bulk, baskets or barrels.

New Catalogs

From Sterling Silver to Door Knobs. Metal polishes to cover this range of work. Matchless Metal Polish Company, 726 Bloomfield Avenue, Glen Ridge, N. J. (560)

Micro-Projectors. Bausch and Lomb Optical Company, Rochester, N. Y. (561)

Erosion; its prevention and cure through the use of Debecote, a condenser tube cement. The Debevoise Company, 968 Grand Street, Brooklyn, N. Y. (562)

New Improved Trip-Lever Pop-Up Bath Drain. Royal Brass Manufacturing Company, Cleveland, Ohio. (563)

Anaconda Nickel Silver. One of the most comprehensive treatments of this metal ever prepared for the metal manufacturing field, covering a wide range of mixtures including Ambrac, Super-Nickel, Cupro Nickel, Benedict Nickel and Pope's Island White Metal. American Brass Company, Waterbury, Conn. (564)

American Dustube Collector. An illustrated folder showing the features of the design and many of the dusts or materials which could be collected. American Foundry Equipment Company, 408 Byrkit Street, Mishawaka, Ind. (565)

Metals Covered with an Adhesive Gummed Paper; to protect the metal from scratches and marring while fabricating. Three folders on this interesting combination. American Nickeloid Company, Peru, Ill. (566)

Heating Garages by Means of the Floodlight Principle. Bulletin No. G-1. L. J. Wing Manufacturing Company, 154 West 14th Street, New York. (567)

Electric Furnaces for Heat Treating. Types B and BA. Harold E. Trent Company, 618-40 N. 54th Street, Philadelphia, Pa. (568)

Thermometer and Thermocouple Calibration Tanks and Furnaces. Harold E. Trent Company, 618-40 N. 54th Street, Philadelphia, Pa. (569)

Ball Anodes for Efficient, Economical Electroplating. The Udylite Company, 1651 E. Grand Boulevard, Detroit, Mich. (570)

Simplified Optical Pyrometer. Catalog No. 70. Pyrometer Instrument Company, 103 Lafayette Street, New York. (571)

Worthington Horizontal Duplex Piston Pumps. Type TA. Worthington Pump & Machinery Corporation, Harrison, N. J. (572)

Worthington Diesel Engines. Bulletin S-500-B30. Worthington Pump & Machinery Corporation, Harrison, N. J. (573)

Handbook on Design of Metal Parts for Porcelain Enameling, No. 1 (pressed steel shapes). Porcelain Enamel Institute, 612 N. Michigan Avenue, Chicago, Ill. (574)

Convected Air, Gas Heated Tempering Furnaces. Bulletin No. 40. Despatch Oven Company, Minneapolis, Minn. (575)

Associations and Societies

American Foundrymen's Association

222 West Adams St., Chicago, Ill.

According to regulations governing the Non-Ferrous Division, the chairman appoints, during the odd numbered years, a Nominating Committee of three to present nominees for Division Chairman, Vice Chairman and four members of the Advisory Committee.

In making its report, this Committee has presented the following names as nominees for officers and executive committee members to be voted upon at the Division business meeting which will be held during the Detroit Convention:

For Chairman, to Serve for Two Years:

Harry M. St. John, Metallurgist, Detroit Lubricator Company, Detroit.

For Vice Chairman, to Serve for Two Years:

Harold J. Roast, Vice President, Canadian Bronze Company, Montreal, P. Q., Canada.

For Members of the Advisory Committee, to Serve for Four Years:

J. J. Curren, Research Metallurgist, Walworth Company, Greensburg, Pa.

D. M. Curry, International Nickel Company, Inc., New York, N. Y.

John H. Diedrich, General Manager, Blackhawk Foundry & Machine Company, Davenport, Iowa.

William J. Laird, Metallurgist, Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa.

According to the Division regulations, other names may be submitted by petition of 25 members. Such petitions should be submitted to the Secretary of the Division, 222 West Adams St., Chicago, Ill.

Lester B. Knight, Jr., vice-president in charge of sales, National Engineering Company, Chicago, has been selected as the author of the Association's official exchange paper to be presented at the 1936 Convention of the Association Technique de Fonderie, the foundry technical association of France, which will be held in Lille, in June, 1936. Mr. Knight's paper will deal with the more recent developments in sand conditioning and handling.

Mr. Knight has been an active worker with various committees of the A.F.A., and has served on the Sand Research Shop Operation and Program Committees.

Milwaukee Branch, A.E.S.

c/o Roman C. Binder, 1515 W. Atkinson Avenue

The program of the annual educational meeting to be held on March 21st has been arranged. The speakers and their papers will be as follows:

Bright Nickel Plating, by **Oliver J. Sizelove,** Frederick Gumm Chemical Company.

Are the Operations Prior to Plating Important? By C. Clindinin, Crown Rheostat and Supply Company.

Protective Coatings of Metals, by George B. Hogaboom, Hanson-Van Winkle-Munning Company. This talk will be illustrated.

The meeting which will be held in the Green Room, Hotel Schroeder, corner

No. 5th Street and Wisconsin Avenue, will be followed by a buffet lunch and refreshments. The reasonable price of $2.00 per person will cover all expenses.

Masters' Electro-Plating Association

123 William Street, New York

The first annual banquet and entertainment of the Masters' Electro-Plating Association was held on Friday, March 6, 1936, at the Brittany, 55 East 10th Street, New York.

The banquet began at 7 P.M. and was attended by over 100 members and guests. This was followed by an entertainment consisting of musicians, singers and dancers. The feature of the evening was the magician performances of **George Morrow** of the Egyptian Lacquer Manufacturing Company, whose performances at banquets of the American Electro-Platers' Society have made him famous.

Everyone had a thoroughly enjoyable time and the object of the meeting, which was to bring the trade together in a social, friendly fashion, was fully attained.

American Electro-Platers' Society

c/o E. Steen Thompson, 905 W. 10th Street, Erie, Pa.

Space in the Cleveland show is going at a rapid rate. Listed below are the concerns who have requested space in the Exhibition.

FIRM	BOOTHS
Belke Manufacturing Company	2
G. S. Blakeslee Company	1
Bruce Products Corporation	1
Bullard Company	1
Carborundum Company	2
Detroit Rex Products Company	1
E. I. duPont de Nemours Company	2
Duriron Company	1
Egyptian Lacquer Manufacturing Company	1
J. B. Ford Sales Company	1
Grasselli Chemical Company	2
Hammond Machinery Builders Inc.	2
Hanson-Van Winkle-Munning Company	3
Kocour Company	1
Lasalco Inc.	1
Lea Manufacturing Company	1
MacFarland Manufacturing Company, Inc.	2
Maas & Waldstein	1
Magnus Chemical Company	1
J. C. Miller Company	1
Norton Company	2
Oakite Products Inc.	1
Philadelphia Quartz Company	1
N. Ransohoff, Inc.	2
Roxalin Flexible Lacquer Manufacturing Company	1
Seymour Manufacturing Company	1
Frederic B. Stevens, Inc.	2
Williamsville Buff Manufacturing Company	1
Udylite Company	3

This Show will be held in connection with the Convention, June 1-4, 1936.

Waste Material Dealers, Inc.

Times Building, New York

The opening session of the 3-day Convention of the National Association of Waste Material Dealers, Inc., which is to be held at the Hotel Astor, New York, March 16th to 18th, inclusive, will be in the nature of a Waste Material Forum.

While the program for this interesting session has not been completed as yet, some of the highlights are as follows: There will be presented at this session, by one who has spent twenty-five years with a large industrial concern, a paper entitled "How Waste Material Dealers Can Strengthen Their Buying Connections With Industrial Concerns." Another paper is in preparation on the subject "Can a Trade Association Be Expected to Solve Industry Problems Which are Economic in Origin?"; while a purchasing agent of a large concern consuming waste materials is to be invited to address those attending on the subject "How Waste Material Dealers Can Strengthen Their Connections With Consumers." These are only a few of the many subjects which have been suggested to the Program Committee for incorporation in the program for this important session.

The Forum session will be held on Monday, March 16th, starting promptly at 2 P. M. and will be an open meeting for the entire Waste Material Trade.

Reduced Rates to the Convention

Members will be able to secure a substantial reduction in fare in attending the Convention.

The Association has been granted what is known as the Identification Certificate Plan, which enables a member to purchase a round trip ticket at the cost of the fare one way plus one-third of the fare for the return journey.

Tickets are good for a 30-day period also for stop-overs. Upon request a member may travel to New York over one route and return to his home by an entirely different route. The reduced rate also applies to member-company employees and members of their families. Identification Certificates under which these greatly reduced rates are obtainable are now ready for distribution.

Friedlander Re-Nominated President

The Nominating Committee, has unanimously renominated Edward B. Friedlander, of the Loewenthal Company, Chicago, for a second term.

Mr. Friedlander was first elected President at the Convention in March, 1935, in Chicago.

The Jewelers Board of Trade

Turk's Head Bldg., Providence, R. I.

At the regular meeting of the Directors of The Manufacturing Jewelers Board of Trade, held in Providence, Rhode Island, on Friday, February 21, 1936, the following officers and members of the Executive Committee were elected:

President—Frederick A. Ballou, Jr., B. A. Ballou & Company, Inc., Providence, R. I.

1st Vice President—Howard L. Carpenter, The Albert Walker Company, Providence, R. I.

2nd Vice President—Russell G. Scott, Reed & Barton Corporation, Taunton, Mass.

Secretary and Treasurer—Horace M. Peck.

Assistant Secretary and Assistant Treasurer—Robert C. Knox.

Royal J. Gregg of the **Ostby & Barton Company,** Providence, Rhode Island, was elected a member of the Executive Committee to serve for three years. The Executive Committee for 1936 is composed of the following: **Frederick A. Ballou, Jr.; Edgar M. Docherty, Royal J. Gregg.**

Personals

JOHN L. CHRISTIE

John L. Christie

John L. Christie was elected a director of the American Institute of Mining and Metallurgical Engineers at the meeting held in New York, February 17-21. Mr. Christie has for years been an active member of the Institute of Metals Division, of which he was chairman in 1934.

Mr. Christie was born in Montclair, N. J., in 1894. He attended the public schools there and graduated from Montclair High School in 1912. He took a regular three-course in chemistry at Sheffield Scientific School, Yale University, graduating with a Ph.B. in 1915. In October of that year he entered the employ of the Bridgeport Brass Company and spent his first two years in New Haven studying metallagraphy under Dr. C. H. Mathewson, receiving his degree of M.S. in 1917. He worked in the chemical and physical testing

laboratories of the Bridgeport Brass Company, and on various mill and factory problems of a metallurgical nature. In 1919 he was placed in charge of the laboratories of the company.

Mr. Christie was married in 1925 to Aretta Sherwood Burr. They have three sons and live in Fairfield, Conn.

Mr. Christie is a member of a number of technical societies including the American Institute of Mining and Metallurgical Engineers, American Chemical Society, Electrochemical Society, American Society for Metals, American Society for Testing Materials and the Institute of Metals (British). He has been active in committee work in the American Society for Testing Materials and the American Institute of Mining and Metallurgical Engineers. Mr. Christie is also a member of the University and Contemporary Clubs of Bridgeport; president of the Bridgeport Travelers Aid Society and a member of the Board of Directors of the Fairfield Family Welfare Society. He is a member of St. Paul's Episcopal Church, Fairfield.

C. N. White, foundry superintendent, **Kelsey-Hayes Wheel Company,** Detroit, Mich., recently resigned. **L. D. Brady** has been appointed superintendent in his place. The above company operates the following departments: tool room, stamping, zincing, plating, polishing, grinding room, grey iron and steel casting foundry.

George P. Halliwell, formerly Assistant Professor of Metallurgy at Carnegie Institute of Technology, has been appointed Director of Research at **H. Kramer & Company,** Chicago, refiners of non-ferrous metal scrap and producers of brass ingots and non-ferrous alloys.

Fred R. Daniels, has rejoined the Waterbury-Farrel Foundry & Machine Company, Waterbury, Conn., Jan. 1, as publicity manager.

Chase Company Personnel Changes

Several changes in the personnel of the officers of the **Chase Companies, Inc.,** were announced recently. **Frederic S. Chase** was re-elected president at the annual meeting; **R. D. Ely,** vice-president in charge of production; **R. L. Coe,** vice-president in charge of sales; **C. E. Hart, Jr.,** secretary; **Rodney Chase,** assistant secretary; **John H. Gilbert,** treasurer. **Mr. Gilbert** succeeds **Mr. Ely** as treasurer, the former being relieved of the responsibilities of office so as to permit him to devote his time in supervising production. The resignation of **Wm. T. Purdy** as comptroller was accepted. **Mr. Purdy** is returning to Boston where he formerly resided. He will maintain his contact with the companies, it has been announced, in an advisory capacity.

Obituaries

Clive B. Vincent

Clive B. Vincent, 72, chairman of the board of directors of the Torrington Company, died at his home, 67 Forest Street, this city, Feb. 4. He was born in Oriskany, N. Y., but had lived here 41 years during all that time being associated with the Torrington Company. After a short time with it he was elected secretary and treasurer and held those offices for 30 years until elected chairman of the board six years ago. He was also a director and the secretary and treasurer of the **Dayton Manufacturing Company,** a director of the **Torrington Manufacturing Company,** the **Hotchkiss Brothers Company,** the **Brooks Bank & Trust Company** and the **Litchfield Savings Society.**

He was a Mason and Knight Templar, a member of the Episcopal Church, the Torrington Club, the Torrington Country Club and the Litchfield Country Club. He was married to Jennie E. Hotchkiss of Torrington in 1901. He is survived by his wife and by a niece, Mrs. A. E. Woodward of Minneapolis, a nephew, Ralph Vincent of Madison, Wis.

William R. Reid, president of the Torrington Company, said: Mr. Vincent had unusually sound and conservative judgment. His wide knowledge of finances and taxes has been invaluable to the Torrington Company.—W. R. B.

Joseph W. Marsh

Joseph W. Marsh, vice-chairman of the board of the General Cable Corporation, died in Pittsburgh, Pa., after an illness of a few days. He was 78 years old. Mr. Marsh also was a director and member of the executive committee of the Westinghouse Electric and Manufacturing Company, and a director of the Westinghouse Electro International Company. He came to Pittsburgh in 1881 from Baltic, Ohio, after moving there from New York City, his birthplace.

Mr. Marsh had patents on a number of improvements in electric wires and cables and was the author of "A Handbook of Useful Information", published in 1892, 1897 and 1905, relating to electric wires and cables.

Surviving are his wife, Mrs. Rose Ingraham Marsh, three daughters and a son.

Frederick S. Magnus

The many friends of Frederick S. Magnus, Vice President and Treasurer of Maas and Waldstein Company, Inc., Newark, N. J., will regret to learn that on February 16 he died of heart failure after an illness of several months.

Mr. Magnus, who was 66 years old, came to this country from England a half century ago. He joined the Maas and Waldstein organization in 1911, and in 1914 was made Vice President and Treasurer.

Always active in the mangement of his own company, Mr. Magnus became a prominent figure in the American lacquer industry, where he gained widespread recognition for his high ideals of business ethics and his great practical knowledge. His opinion and advice were constantly sought by those concerned with all phases of the finishing industry.

Walter L. Kalbach

Walter L. Kalbach, manufacturer of wood and metal patterns, Philadelphia, Pa., died recently after a long illness. Mr. Kalbach was 59 years old.

He was the son of the late Mr. and Mrs. William Kalbach, and was born and educated in Philadelphia, Pa. He had been in business for 32 years. For more than 21 years his place of business was at 12th and Oliver Streets. Mr. Kalbach was past president of the Master Pattern Makers Association and a member of the American Foundrymen's Association, and Franklin Lodge No. 134, F. & A. M.

Maurice Weill

Maurice Weill, 82 years old, 5036 Drexel Boulevard, Chicago, Ill., founder of the Illinois Smelting and Refining Company, died recently.

Mr. Weill was born in Alsace and came to Chicago in 1873. He entered the metal business and later formed his own company, which, in the 1890's was regarded as one of the largest in the state. He also founded the Sandoval Zinc Company in Sandoval, Ill. He retired from business three years ago.

Anthony J. Detlaff

Anthony J. Detlaff, president of A. J. Detlaff & Company, foundry and manufacturers of brass bushings, died on February 4, at his home, 3010 Glendale Avenue, at the age of 69. He was born in Germany, but had lived in Detroit since he was a child.—F. J. H.

Edward Brunhoff

Edward Brunhoff, president and founder of the Brunhoff Manufacturing Company, makers of metals and advertising specialties, died on February 3, at his home, 225 West Hill Lane, Wyoming. He was 72 years old.

James H. Coleman

James H. Coleman, 63, for 20 years in charge of the Cleveland district for the Tabor Manufacturing Company, died recently after a short illness. Mr. Coleman was born in West Eaton, N. Y., and went to Cleveland 21 years ago.

John Henley

John Henley, one of the organizers of the Chicago Extruded Metals Company, 1602 South 54th Avenue, Cicero, Ill., in 1922, occupying the position of vice-president, passed away suddenly of heart trouble on January 30.

Mr. Henley was born in Manchester, England, on August 8, 1879. He started in the mechanical department of the Kenosha branch of the American Brass Company (then known as the Chicago Brass Company) in 1901, and was with them continually except for a very short period until 1922, at which time he occupied the position of assistant master mechanic.

Mr. Henley is survived by his wife and one son, Thomas J. Henley.

William H. Folsom

William H. Folsom for many years purchasing agent for several Southern railroads and subsequently a partner of the Exeter Brass Works for some time, died at his home in Exeter, N. J., on January 26. Mr. Folsom was born in Exeter 77 years ago, and was graduated from Harvard University in 1881.

Theodore Clyde Foster

Theodore Clyde Foster, 62 years old, president and treasurer of Theodore W. Foster and Brother Company, Providence, R. I., jewelers and silversmiths of this city, died on February 1.

Joseph Straub

Joseph Straub, foreman plater for R. H. Macy Company, New York, passed away recently. He was a prominent member of the New York Branch of the American Electro-Platers' Society.

Industrial and Financial News

Metal Developments

The first of the second million of certified lamps, a special lamp of Brazilian Onyx in 24-Karat gold plate, was recently presented to **A. W. Robertson,** Chairman of the Board of the **Westinghouse Electric and Manufacturing Company,** East Pittsburgh, Pa., in Rockefeller Center, New York. **Frederick Schwartz,** vice-president of the **Artistic Lamp Manufacturing Company,** presented the lamp as a gift to Mr. Robertson in commemoration of the Westinghouse Golden Jubilee year.

Imports of **aluminum** into the United States in 1935 totalled 21,075,683 pounds, the heaviest since 1930.

John H. Goss, vice-president and general superintendent of the **Scovill Manufacturing Company,** Waterbury, Conn., stated, in a speech before the Scovill Manufacturing Company Foremen's Association, at the 22nd annual meeting in Waterbury, Conn., that the company was experiencing its best year since 1929.

Members of the **New England Manufacturing Jewelers' and Silversmiths' Association** recently were treated to a complete showing of the latest trends in jewelry design by **Levon Babayan,** Paris, France. It is the plan of this Association to devote more attention to the latest designs to harmonize with styles in women's clothing, in order to maintain their position as leading manufacturers of medium and low-priced jewelry.

In a recent highly successful 300-hour Government supervised run conducted at the **Casey Jones School of Aeronautics,** Newark, N. J., an airplane propeller was driven from a low cost stock automobile motor, fueled with ordinary commercial grades of gasoline, and the power was transmitted by six stock Condor V-belts of the same construction as those made for commercial drives by the **Manhattan Rubber Manufacturing Division** of **Raybestos-Manhattan, Inc.,** Passaic, N. J.

Capital to Invest

L. M. Demarest and Associates, 230 Park Avenue, New York, report that a number of their clients are interested in purchasing going manufacturing businesses or manufactured products to manufacture, among which are the following:

Business making a specialty of products utilizing copper or brass.

Business specializing in the manufacture of resistance wires.

Business making electrical devices, such as temperature controls, switches, etc.

Business making fastenings of some nature.

Chemical business, specialties preferred.

Company making products of tin or light metals, hardware preferred.

Product using chiefly non-ferrous metals for industrial or consumer use; stamping or machine screw work.

Patented metal product, preferably using stampings.

Special machines already developed.

Corporation Earnings

Net Profit Unless Followed by (L) Which Is Loss

	1935	1934
Anaconda Copper Mining Company	$11,181,348	$1,960,094
Anaconda Wire & Cable Company	1,029,402	821,802
Arrow, Hart & Hegeman Electric Company	643,555	252,627
Federal Mogul Corporation	209,264	102,028
General Bronze Corporation	80,366	460,239 (L)
General Cable Corporation	33,132	526,078 (L)
National Bearing Metals Corporation	433,343	329,533
New Haven Clock Company	116,400	98,560
New Jersey Zinc Company	4,666,000	3,788,380
Ohio Brass Company	348,992	500,271
Plume & Atwood	165,465	.....
Veeder Root, Inc.	499,551	278,316

Business Items-Verified

Doehler Die Casting Company, Toledo, Ohio, intends to rebuild and modernize present Pottstown plant at an estimated cost of $200,000.

Zapon-Brevolite Division, Atlas Powder Company, 20th Street and Sheridan Road, North Chicago, Ill., has let general contract for three-story addition, 50 x 80 ft., for manufacturing service and one-story unit adjoining for storage and distribution. Cost, over $50,000 with equipment.

C. & G. Foundry and Pattern Works, Indianapolis, Ind., recently celebrated its 60th anniversary. The firm was established in 1919 by Charles J. Gisler. Officials of the company report that their business for the first three-quarters of last year practically doubled that of the corresponding period of 1934. The firm operates the following departments: bronze, brass and aluminum foundry.

Werner Manufacturing Company, Milwaukee, Wis., has been incorporated by Richard W. Werner, 1614 E. Royall Place, and associates, to manufacture automotive parts and accessories, mechanical appliances, stampings, etc. A factory is now being equipped. The firm is located at 775 N. Water St.

The **Fox Foundry and Supply Company** has been established at 2627 E. York Street under the management of

George Fox. The firm is continuing the business formerly conducted by the Kappeer Fox Foundry Company at same address. The following departments are operated: brass, bronze and aluminum foundry.

Casco Products Corporation, Railroad Avenue, Bridgeport, Conn., manufacturer of automotive parts and equipment has let general contract for one-story addition, 90 x 180 ft. Cost over $10,000 with equipment. This firm operates the following departments: tool room, stamping, soldering, plating, polishing, lacquering, japanning.

Lea Manufacturing Company, Waterbury, Conn., now carry a comprehensive stock of Merck laboratory chemicals. They are in a position to supply these chemicals to consumers in Connecticut and nearby parts of Massachusetts.

Frank S. Davidson, manager of the **Davidson Enameling Products Company,** Lima, Ohio, announces the purchase of the Lima Metal Product Inc., plant. The price is said to exceed $50,000. The plant will be used for fabrication of metals in preparation for enameling.

Newark Wire Cloth Company, Newark, N. J., manufacturers of high grade wire cloth and wire cloth products, announces that it has appointed Robert H. Brinton, 1640 Castle Court, Houston, Tex., as Texas representative. The address is P. O. Box 1970, Houston.

Colt's Patent Fire Arms Manufacturing Company has promoted **L. H. McLure** to sales manager of its electrical division. Mr. McLure has been identified with this company since 1918. He is a graduate of Trinity College from where he went directly to his first position with the Hartford Electric Light Company.

Special Chemicals Corporation, 30 Irving Place, New York, announces that it has doubled its floor space due to increase in business.

The **Lea Manufacturing Company,** Waterbury, Conn., producers of Lea Compound, Learok and Lea Nickel Glo announce an added service to the plating industry. Extensive facilities have been installed for coating plating racks with Kote-Rax, a tough translucent, rubber-like compound with high corrosion resisting properties and dielectric strength which was described in **Metal Industry** for August, 1935, p. 298.

Advance Aluminum and Brass Company, Los Angeles, Calif., has announced that they are now located at 1001 East Slauson Avenue. The company operates the following departments: bronze, brass and aluminum foundry; brass machine shop, tool room, tinning, soldering, brazing, polishing, grinding room and lacquering.

Albra Castings Corporation, Huntington, Ind., has been incorporated as a preliminary step to taking over the property and business of the Rinebolt Foundry Company of that city. The company will produce non-ferrous castings. Incorporators are: H. Voges, Jr., president; V. W. Pacula, vice-president and plant superintendent; S. W. Richey, secretary; C. L. Terrell, treasurer; and B. W. Voges, director. The company operates the following departments: bronze, brass and aluminum foundry; casting shop, grinding room.

The **Owen-Dyneto Corporation,** Syracuse, N. Y., has moved its welder division from the USL Battery Corporation, Niagara Falls, N. Y., to the Owen-Dyneto Corporation in Syracuse. **J. L. Fosnight** will continue as sales manager of the electric arc welding division. All USL arc welding equipment will be manufactured and sold by the Owen-Dyneto Corporation.

United Engineering and Foundry Company, Pittsburgh, Pa., has acquired the Wooster, Ohio, plant of the Mackintosh-Hemphill Company, for the manufacture of rolling mill equipment.

Whitehead Metal Products Company, 304 Hudson Street, New York City, has increased its office space by 50 per cent. The company now has 15,000 sq. ft. of office space and 30,000 sq. ft. of warehouse at this location. The company is distributor for the products of the International Nickel Company, American Brass Company and the Aluminum Company of America. It also maintains warehouses in Bronx, Brooklyn and five other cities for the distribution of these products, and also Monel metal sinks, Monel metal hot water storage tanks and gas hot water heaters, which it manufactures at its plant in Cambridge, Mass.

Grand Rapids Stamping Division of **General Motors Corporation,** Grand Rapids, Mich., has let contract for erection of new stamping and die manufacturing plant.

Panama Air Depot, France Field, Canal Zone, has recently installed a cadmium plating outfit and is considering extending it to include chromium both for corrosion resistance and for tool bit hardening. **W. A. Key** is foreman of the Construction and Electrical Department.

The **Clark Tructractor Company,** Battle Creek, Michigan, manufacturers of gas-powered industrial trucks, tructiers, and tractors for material-handling operations announce that **Harry B. Clapp** has joined its staff as Transportation Engineer. Mr. Clapp will make his headquarters at Battle Creek as special engineering assistant to **Ezra W. Clark,** Vice President.

The **Detroit Rex Products Company,** 13008 Hillview Ave., Detroit, Mich., manufacturers of Detrex Solvent Degreasers, Triad and Perm-A-Clor non-inflammable solvents, and a complete line of Triad Alkali cleaning compounds and enamel strippers, has moved the offices of their Eastern Sales Region to Room 816, Bush Terminal Sales Bldg., 130 West 42nd Street, New York City. This region, which is under the supervision of **D. E. Williard,** Eastern Sales Manager, consists of the New England states, the south-east corner of New York state, eastern half of Pennsylvania, New Jersey, Delaware and eastern Maryland. The various representatives covering this territory will work out of Boston, New Haven, New York City and Philadelphia.

Modine Manufacturing Company, Racine, Wisconsin, announces the appointment of Charles J. Gaskell as its representative in Memphis, Tennessee. **Mr. Gaskell,** as Memphis representative for Modine, (manufacturers of unit heaters, copper radiation, unit coolers, and heat transfer equipment) will cover the western part of Tennessee, the northern part of Mississippi and the eastern part of Arkansas. His office is located in the Falls Building in Memphis.

With the completion of their new plant in the Clearing Industrial District, near Chicago, **Apollo Metal Works, Inc.,** manufacturers of pre-finished metals, have announced the moving of their general offices and mill from La Salle, Illinois, to the new site. The Clearing Industrial District is a 2,800-acre manufacturing area which houses 108 large factories and adjoins the southwest edge of Chicago. The approximate cost of the land and new factory building, which contains 35,000 square feet, was $120,000. Apollo Metal Works, Incorporated in 1915, has offices in 17 principal cities throughout the United States, and one in Montreal. In addition to the Chicago plant, there is a mill in Bethlehem, Pa., but the general offices will now also be located in Clearing. The new building is a one-story plant with its own individual switch track added.

At a recent meeting of the Board of Directors of the **Acklin Stamping Company,** the Directors elected **William Collard Acklin** as president to fill the unexpired term of the late **James Montgomery Acklin. William C. Acklin** has been secretary of the company since 1911, occupying the position of general manager since 1926. On assuming the position of president, **Mr. Acklin** resigned as secretary and the vacancy in this office was filled by the election of **George F. Medill,** member of a prominent Toledo law firm. Other officers of the company are **Frank E. Graper,** first vice-president and works manager, **F. C. Greenhill,** second vice-president and sales manager, and **A. E. Seeman,** treasurer and assistant secretary. The vacancy on the Board of Directors, occasioned by the death of **James Acklin,** will be filled at the meeting of stockholders to be held in February.

The rouge and composition business of **Zucker Sons' Company,** of Roselle, N. J., known as the "Pioneer" line of rouges and allied products for jewelry, cutlery, silverware, stainless steel, chro-

mium, fine brass, nickel, has been purchased by **Frederic B. Stevens, Inc.**, Detroit, Michigan, who have been actively engaged in the manufacture of buffing composition for some 45 years. The Zucker equipment has been moved to Detroit and a new addition to the Stevens buffing composition plant has been erected to accommodate it. **F. A. Zucker**, senior member of the former **Zucker Sons' Company,** is in Detroit and will continue to supervise the manufacture and distribution of these products. The quality will be maintained as heretofore and all orders for the United States, Canada, and foreign countries will be handled exactly as in the past.

The **District Court of the United States** for the **Northern District of Illinois,** Eastern Division, has handed down a decision holding U. S. Patents No. 1,734,706 and No. 1,962,821 held by the Diversey Corporation, 53 W. Jackson Blvd., Chicago, Ill., valid and infringed. The opinion was written by **Judge Walter C. Lindley,** and, in addition to directing an injunction, ordered an accounting for damages and profits.

The Defendant is **L. Carlton Mertz,** doing business as the **L. Carlton Mertz Company.** Officials of **The Diversey Corporation** state that the patents, which were declared valid and infringed, cover the composition and method for their product, Protex Metallum, the non-corrosive alkaline detergent.

William S. Smulski, mechanical engineer, 3441 S. 14th Street, Milwaukee, Wis., in association with **Thomas A. Daroszuk** and **Chester Fabisiak,** has organized the **Dorfalloy Company,** to manufacture and fabricate metal products, alloys, etc. Details will be announced later. The company will operate the following departments: bronze foundry, copper alloy manufacturing.

The **Illinois Testing Laboratories, Inc.,** 420 North LaSalle Street, Chicago, Ill., manufacturers of "Alnor" and "Price" pyrometers and the Velometer, for measuring air velocity announce the appointment of **Ralph W. Bergen** with offices at 328 Chestnut Street, Philadelphia, Pa., as their representative for Maryland, Delaware, Southern New Jersey and Eastern Pennsylvania.

The **Hobart Brothers Company,** Troy, Ohio, announces that the **J. C. Gowing Welding Equipment and Supply Company, Jim Gowing,** manager, has been appointed exclusive distributor for Hobart Electric Arc Welders in Southern California. Their new location at the corner of Laura and Regent, 1 block South of Slauson, two blocks West of Santa Fe, Huntington Park, Cal., offers a complete line of Hobart Simplified Arc Welders and Supplies.

The **Stanley Chemical Company** of East Berlin, Conn., announce the addition to their sales staff of **Charles M. Rice** with permanent headquarters in Philadelphia.

News From Metal Industry Correspondents

New England States

Waterbury, Conn.

March 2, 1936.

Two changes were made at the annual election of officers of the **Chase Companies, Inc.,** last month. **R. D. Ely** resigned his office as treasurer to devote all his time to the position of vice-president in charge of production of all the Chase companies. **W. A. Purdy** resigned as controller. The following are the officers elected: President, **F. S. Chase;** vice-president in charge of production, **R. D. Ely;** vice-president in charge of sales, **R. L. Coe;** secretary, **C. E. Hart, Jr.;** assistant secretary, **Rodney Chase;** treasurer, **John H. Gilbert.** President **F. S. Chase** said that the organization regretted that Mr. Purdy felt he could not continue his active duties as controller but that he would continue in an advisory capacity, available when conditions arise when his experience will be of help. It is understood he will return to Boston where he lived before coming here.

Officers of the **Plume & Atwood Manufacturing Company** were reelected last month as follows: President **R. L. French;** vice-president, **S. Kellogg Plume;** secretary, **John L. Scott;** treasurer, **R. L. French;** directors, **Leroy S. Andrews, R. L. French, Willis M. Hall, Emil Mannweiller, S. K. Plume, J. L. Scott** and **Thomas B. Thatcher.**

Congressman **J. Joseph Smith,** at the request of **C. H. Granger,** vice-president of the **Waterbury Clock Company** has obtained a change in the proposed regulation of the Federal Alcohol Control Administration so as to allow distillers and brewers to give advertising gifts of clocks to retailers, provided the cost is not over $10 each. The previous regulation forbade any advertising gifts costing over 10 cents.

The **Scovill Manufacturing Company,** the **Chase Companies, Inc.,** and the **Bristol Company** of this city, have entered exhibits for the International Petroleum exposition at Tulsa, Okla., May 16 to 23.

It is learned that in the Boulder Dam, just compelted, there are more than 250,000 pounds of **American Brass Company** products, consisting chiefly of the ventilated bus structures for the 4,000 ampere, 23,000 volts, 3-phase, 60-cycle current that will be generated there.

The first all-copper house in the state is being built in Watertown, near here, by **Gerald C. Low,** a state bank examiner. All the material was made by the **Chase Companies, Inc.** The outside walls, roof and roofing accessories are entirely of copper, and the plumbing and heating lines and interior hardware are of copper or copper alloys. The plans were drawn by the **Copper Houses, Inc.,** a subsidiary of the **Chase Companies.** The walls are made of sheets of copper with crimped edges, turned at right angles, and locked together with bars running through the edges with bolts which pull the sheets tightly together.

—W. R. B.

Connecticut Notes

March 2, 1936.

HARTFORD. **Colt's Patent Fire Arm Manufacturing Company** plant was given a valuation of $5,686,585 by the valuation engineer of the Interstate Commerce Commission in the hearings in Washington last month on the proposal that the Government take over the manufacture of munitions. At the same time, the engineer testified that if the Government were to duplicate the plant so it could go into the manufacture of machine guns and small arms the cost would run up to $8,800,000, including land. The last financial statement of Colt's shows the plant and equipment carried at $2,818,000.

Arrow, Hart & Hegeman Electric Company reports net income of $643,555 for 1935, before dividends. At the annual meeting last month **Mitchell S. Little** and **Harrison C. Bracken** were added to the board of directors. **Mr. Little** is president of the **M. S. Little Manufacturing Company,** the **Smyth Manufacturing Company,** and the **Sigourney Tool Company.** He takes the place of the late **Daniel J. Glazier. Edward R. Grier,** chairman of the board, and **John R. Cook,** president, and associate officers were reelected. **Grosvenor C. Barry,** general sales manager, was elected a vice-president, and **Leroy G. Stevenson** was elected as assistant treasurer. **Mr. Stevenson** has been manager of the accounting department.

NEW BRITAIN. At the annual election of officers of the **American Hardware Corporation** here last month the only change was the election of **Austin**

L. Adams as a director to succeed **Carlisle H. Baldwin. Mr. Adams** is president of the **Colonial Trust Company** of Waterbury and of the **Naugatuck National Bank** of Naugatuck. **Mr. Baldwin** recently resigned not only as director but as general manager of the **Corbin Cabinet Lock Company** division.

MERIDEN. Over 100 salesmen of the **International Silver Company, 1847 Rogers' Brothers and William Rogers & Sons,** attended a three-day sales conference in this city last month. The conference was under the direction of **Craig D. Munson,** vice-president and general sales manager, assisted by **C. C. Gabel** divisional sales manager and **K. F. Whatmore,** advertising manager.

The city's assessment for taxation purposes gives the **International Silver Company's** plant in this city a valuation of $3,309,170. The **Meriden Division** of the **New Departure Company** is assessed at $2,263,095. **The Miller Company,** electric and lighting manufacturers, assessed at $737,025; the **Bradley & Hubbard Manufacturing Company** at $733,-136, and the **Charles Parker Company,** firearms manufacturers, at $513,680.

NEW HAVEN. The **New Haven Clock Company** has declared a dividend of $1.62½ on the accumulated preferred stock, reducing the amount due to $16.25 a share. It was paid Feb. 1.

SOUTHINGTON. The **Southington Hardware Company** has voted that, because of present conditions, it is unwise to declare a dividend. Until now the company has paid dividends regularly.—**W. R. B.**

Providence, R. I.

March 2, 1936.

While the employment in manufacturing plants of Rhode Island declined 1.8 per cent during the month of December, according to the monthly summary by the State Department of Labor issued Jan. 30, the metal trades were one of the two industries that registered an increase for that month of 2.4 per cent as compared with the preceding month and a gain of 19.3 per cent as against the employment in December, 1934. Two hundred and eighty-eight manufacturing plants, including 36 metal trades concerns reported 74,511 persons employed, of whom 8,959 were in the metal trades plants, at the close of December, 1935, as against 75,885 at the end of the preceding month and 71,904 at the close of December, 1934. The 36 metal trades concerns reported 8,959 persons on the payrolls, which was 2.4 per cent more than in November and 19.3 per cent advance as compared with the previous December.

In the manufacturing jewelry and silverware industries twenty-seven plants reported 4,554 persons on the payrolls at the close of the year 1935 which, although 13.2 per cent below those at the close of the preceding month was 2.5 per cent increase over December, 1934. The decrease for the month is a seasonal one but as compared with the figures of the corresponding period of 1934, there is reasonable encouragement throughout the jewelry industry for a good business year.

Rhode Island industry is greatly interested in the additional burdens and increased costs that lie in the proposed changes in the Workmen's Compensation Law contained in House Bill 510 in the Rhode Island General Assembly, now under consideration. It has been indorsed by **L. Metcalfe Walling,** State Director of Labor and the labor organizations. At a meeting held at the **Providence Chamber of Commerce** under the joint auspices of the **Associated Industries of Rhode Island** and the **Rhode Island Branch** of the **National Metal Trades Association** on January 27, some of the objectional features, both technical and legal, were pointed out.

The Art Jewelry Company, 158 Pine street, is owned by **Benjamin Sohn** of 97 Pratt street, according to his statement filed at City Hall.—**W. H. M.**

Middle Atlantic States

Utica, N. Y.

March 2, 1936.

Utica foundries are ahead of other sections of the country in equipment used to fight silicosis in the opinion of **Earl Shartzer,** safety engineer, Utica Mutual Insurance Company, who has been making a study of protection equipment for the industry for the past two years.

Extensive alterations are being made in some of the plants where new equipment is being installed. One of the most recent installations is at the **Hart & Crouse Company.** The **International Heater Company** has had modern equipment for a number of months.

Mr. Shartzer who is preparing a book, "Dust Can Be Controlled," since 1933 has been studying silicosis dangers in anticipation of the legislation in this state and the Utica organization which he represents has instituted a dust prevention program among plants in this state which is attracting wide attention. J. L. Hermann, Paramount News photographer, has just taken pictures of the Hart & Crouse equipment.

The Hart & Crouse sand blast room is made of steel plate and is dust tight. The coarse sand falls through a grate floor and is conveyed to a container for reuse. The room is well lighted and ventilated. The exhaust equipment changes air in the room from 6 to 10 times a minute. The operator is protected by a helmet which is supplied with filtered fresh air. The fine dust created is carried by exhaust pipes to a dust separator outside the building. When the operator finishes blasting a casting, he shuts off the blaster and opens the door to remove the finished casting and take in other castings to be finished. From the time the operator shuts off his equipment, up to the time he opens the door due to the powerful exhaust of the air in the room, the atmosphere has been completely cleared so that there is no dust released to other departments from this source.

With new type collectors in the **Hart & Crouse** foundry dust laden air is drawn through a number of screens covered with a light grade of canvas. These screens are encased in a large dust tight container made of steel plate. A vibrating device shakes the screens and the dust falls to hoppers in the lower part of the separators. The dust laden air is not blown into this type of separator, it is drawn through the blower as it is on the clean side of the mechanism. After passing through this type of separator the air has been completely filtered. All fine particles have been trapped by the screens and deposited in the hoppers for disposal.

Mr. Shartzer is advising these steps to be taken in foundries where silica dust presents the danger of silicosis:

1. Never dry sweep the floors. Wet them down and scrape them. Keep the floors moist preferably with oil spray.
2. Keep the overhead clean, thoroughly clean. This can be done with compressed air and water but the use of a vacuum such as is used in the most modern plants is much better.
3. Have a systematic program of keeping floor clear of refuse sand.
4. With all dust creating machinery; have it equipped with an efficient ventilating and dust collecting system, the screen or stocking type being far better than the old cyclone metnod.

For non-ferrous foundries Mr. Shartzer recommends the centrifugal cleaning equipment without air to the old tumbling barrels which he said are spreading dust and danger wherever they are in operation.

—**E. K. B.**

Newark, N. J.

March 2, 1936.

The **Shiman Manufacturing Company,** jewelry manufacturers of Newark, have moved to a plant on Monroe Street, where they now occupy the third and fourth floors. The old plant of the **Shiman Company,** has been purchased by the **Baker Company** for expansion of the firm's operations.

Vice Chancellor Bigelow has appointed **William Stalford** as Custodial Receiver for the **Shur-Lift Manufacturing Company,** manufacturers of kitchen utensils. The petition for a receiver cites that the concern has practically suspended operations. **E. Weigel & Sons,** manufacturers of steel and gold pens, have purchased a brick plant on First Street.

The following Newark concerns have

been incorporated: **National Metal Products, Inc.**, 100 shares, no par; **Raymond Chemical Company, Inc.**, $100,000; **Du-All Chemical Company**, $50,000; **Newark Machine Company**, tools, 100 shares, no par; **Crown Laboratories**, chemicals, 250 shares, no par.—C. A. L.

Trenton, N. J.

March 2, 1936.

The **Manufacturers' Association** of New Jersey has suggested to employers the setting up of a reserve for unemployment compensations. The reserve is intended to meet payments that would be due January 1, 1937, under the Federal Social Security Act. The Association suggested a contingent liability reserve of 1 per cent on 1936 payrolls. The suggestion was made because of lack of certainty as to legislation that may be adopted by New Jersey to co-operate with the national government in the program.

Joseph M. Roebling, son of **Ferdinand W. Roebling**, has been named second vice-president of the **John A. Roebling's Sons Company**, at a meeting of the board of directors. He has been connected with the company for 12 years and succeeds the late **Siegfried Roebling**. The company is erecting a storage and shipping building at the Woolverton Avenue plant.

The **Keystone Watch Case Company**, Riverside, N. J., has been granted an income tax refund of $180,472.72 from the United States Treasury. Internal revenue agents evaluated inventories for the 1928-29 fiscal year incorrectly, it was stated, and the firm overpaid $185,687.54. The difference between this sum and a deficiency in 1933 of $5,214.82 will be refunded.—C. A. L.

Middle West

Toledo, Ohio

March 2, 1936.

Production has been holding up well in this territory during the past month, although a long stretch of cold weather often has threatened to slow down operations. The manufacture of motor car parts has taken the lead and these plants probably will be active until well along in the spring. Unemployment has been materially reduced, although there still is a surplus of labor. Skilled mechanics, however, find little difficulty fitting in.

Many of the metal plants outside the motor car industry, have stepped up production with prospects favorable for continuous operations over a considerable period. It is gratifying to state that February, with all its weather handicaps, will show decided gains over preceding months and with an industrial record far exceeding the same period of a year ago.

About the same reports come from Cleveland where the metal plants show encouraging gains.

Work for about 2,000 men until early August was assured when Judge George P. Hahn signed an order in the Federal Court, at Toledo, late in January granting production of 15,000 cars by the **Willys-Overland Company**. The order was signed on application of **David R. Wilson**, Receiver for the company.

—F. J. H.

Detroit, Mich.

March 2, 1936.

At Mt. Pleasant **The American Enameled Products Company** also has been incorporated for $100,000.

A. B. Moninger, has been elected a director of the **Parker Rust Proof Company, M. C. Baker** and **R. C. Briston** have also been chosen vice-presidents, and **Robert Englehart**, secretary. At a recent stockholders meeting a plan was approved to increase the capital stock to 500,000 shares of $2.50 par value, from 250,000 shares of no par value and issuance to stockholders of three new shares of stock for each one now held.

The **Renown Stove Company**, Owosso, reports an increase of 32.1 per cent in net sales for 1935, as compared with 1934. The 1934 sales likewise were 108.5 per cent over those for 1933, according to announcement.

More than 35 days of near zero temperatures have slowed up all kinds of business in this area. Not in 50 years, according to those who say they know, has Detroit and all this Great Lakes area experienced such weather. Transportation has been handicapped, delaying incoming supplies and shipping out of completed products. Buying also has been held up with most every one's mind centering on fuel which is none too plentiful. Production schedules in the non-ferrous metals have shown a decline for several days. It is not pronounced, but it is not pleasing when the big plants are supposed to be going at their best. The slowup is attributed altogether to the weather and it is believed with the arrival of higher temperatures manufacturing will shoot ahead again.

Many new motor cars are being turned out, but it is reported there are not the number of orders ahead that there were early in January. Manufacturers of motor parts are active, but it does not seem nearly so difficult for them to keep up with demands as it did a few weeks ago. This also is true of the platers who have to gauge their production according to orders.

Manufacture of refrigeration units is going ahead with much new business in prospect, it is claimed. With a gradual increase in building operations plumbing supplies are in more demand. Considerable pressure is being used in hopes of further advancing this industry.

The plumbing ware division of the **Briggs Manufacturing ompany** is operating on a 24-hour three-shift schedule.

Announcement is made that more than 3,000 persons now are on the payroll of the **Leonard Refrigerator Company**, at Grand Rapids. Frank D. Brebner, factory manager, declares that business is exceptionally good.

The **Packard Motor Car Company** is understood to have scheduled 7,500 cars for March, as against 5,500 for February. The March schedule, if fulfilled, would set a new record for the company.

Two new additions, totalling 57,000 square feet of floor space, have been added to the small parts plant of the **Chevrolet Motor Company** in Bay City. The added space has made possible an increase in production capacity, and parts formerly manufactured at Chevrolet plants in Flint are now produced in the new plant additions in Bay City.

—E. J. H.

Pacific States

Southern California

March 2, 1936.

The **Morris Stamping & Manufacturing Company** has enlarged its plant at 50th and Magnolia Sts.

The **Timm Aircraft Company** has several large contracts for streamlined all metal passenger planes, at its factory here, at Glendale.

The **Crusader Aircraft Corporation** of Denver is moving its plant to Glendale here, to make all metal passenger planes. **T. M. Shelton** is designer and **E. R. Derrington**, chief engineer.

The **Fisher Corporation** of 1261 South Brand Blvd., Glendale, is enlarging its plant to make therapeutic lamps.

Charles P. Stewart of 667 Rowan Bldg., will make sun ray bath cabinets.

The **Parker Company**, making refrigerating apparatus, has moved its plant to East 7th St. near Santa Fe Ave.

The **Magnetic Signal Company** of 3355 East Slauson Ave., is making a new portable water fountain for construction and auto camps. —H. S.

The North Pacific

March 2, 1936.

Clayton H. Englar was made general sales manager, for the **Continental Can Company**, at 155 New Montgomery St., San Francisco.

The **Hammer-Bray Company** of 26th Ave. and East 12th St., Oakland, are building a new factory to make stoves and ranges.

The **Marchant Calculating Machine Company** of the East Bay District, Oakland, has enlarged its factory.

M. E. Marcus of 709 12th St., Sacramento, of the **Marcus Auto Supply Company**, has started manufacturing electric equipment, armatures, generators, etc.

The **Oakley Electric Company** of Boise, Idaho, have started making a contact resurfacer for autos.

The **Decora Mfg. Company** of 2512 Broadway, Oakland, are making a new tire inflator and air gauges.

—H. S.

Metal Market Review

March 2, 1930.

Copper was firm in tone for the entire month. In fact at one time there was a flurry on the announcement that Phelps Dodge were raising their price to 9½c per lb., electrolytic, from 9¼. This move was not followed by the other producers but it gave the market a strong tone. Domestic sales totalled about 9,500 tons the first week, 5,900 tons the second, 57,000 tons (!) during the third and 6,500 tons in the fourth.

Zinc was also firm, resting at 4.85c per pound Prime Western, f.o.b. East St. Louis, until the last few days when it stepped up to 4.90. Demand was rather slow during the first three weeks but producers held firm believing that consumers would have to come into the market soon. Their confidence was justified by the sale of 20,000 tons during the third week of February, after which the advance in price was made.

Tin began the month at 48c per pound Straits, moving uncertainly, with only fair buying. During the third week, however, the International Tin Committee in Paris announced the lowering of production quotas from 90 to 85 per cent and very shortly afterward the market showed the effect of this move, with the metal rising to 48.25.

Tin statistics, in detail up to the end of 1935, were issued by the International Tin Research and Development Council, showing that apparent world consumption had increased over 20 per cent in 1935 over 1934. Consumption in the United States totalled 62,292 long tons in 1935 against 43,601 long tons in 1934, an increase of almost 43 per cent.

Lead followed very closely the course of zinc. It rested comfortably at its previous price of 4.35c per pound, f.o.b. St. Louis until almost the end when it moved up to 4.40. Business was active in the first week, slackened a little in the second, improved again in the third and even more in the last week. Total sales for the month were about 29,000 tons, of which 13,500 tons were sold in the last week, accounting for the rise.

Aluminum remained fixed at its nominal price 22c per pound, actual transactions varying from 19 to 22 with most of the business at about 20. An advance summary of the aluminum industry in 1935 was issued by the U. S. Bureau of Mines. New aluminum produced in the United States during 1935, amounted to 119,295,000 pounds valued at $22,070,000 compared with 74,177,000 pounds valued at $14,094,000 in 1934. World production rose from 170,000 metric tons in 1934 to 257,000 in 1935.

Nickel was unchanged as usual at 35.00c per pound for electrolytic.

Antimony was steady and later developed strength, beginning the month at 12.875c per pound, closed at 13.25. Demand at the latter part of the month, however, was quiet.

Silver, evidently still tired after its violent exercise in recent weeks continued to rest at 44.75c per ounce. Trading was very quiet during the first two weeks, brightened a little during the third on some purchases in London for India, and declined again at the close. Holdings of silver of the U. S. Government now total close to 1,642,000,000 ounces, valued at $2,188,600,000.

Platinum was unmoved throughout the month at $33 per ounce.

Gold was also unchanged at $35 per ounce, U. S. Treasury price. The monetary value of U. S. gold stocks was $10,154,460,467. World gold production established a new high in 1935, according to the American Bureau of Metal Statistics, with a total output of 30,500,000 ounces against 27,300,000 in 1934.

Scrap Metals were decidedly firm. Offerings were small but copper refiners bids were unmoved until the pressure became too great for them, when they were raised. At the end of the month copper scrap was selling at a 9.50 electrolytic basis, which seems to foretell the trend of the primary metal market. The brass and aluminum ingot business was quiet for the first two weeks; brass then spurted on the prospects of a rise in the copper market, but quieted down again toward the last of the month. Aluminum ingot business remained dull. As a result the prices became shaky toward the latter part of the month under competition.

On February 1, unfilled orders for brass and bronze ingots and billets on the books of the members of the Non-Ferrous Ingot Metal Institute amounted to a total of 16,119 net tons. The combined deliveries of brass and bronze ingots and billets by the members for the month of January, 1936, amounted to a total of 5,948 tons.

Average prices per pound during the twenty-eight day period ending February 21 were:

80-10-10 (1½% Imp.)	10.790c
78% Metal	8.503c
81% Metal	8.757c
83% Metal	9.016c
85-5-5-5	9.268c
No. 1 Yellow Brass	7.522c

Wrought Metals were subject to the between-seasons let down of general business. Nevertheless the record for February was very fair. A metropolitan distributor reports that the volume of business was about the same as in January, and 40% over February, 1935.

The Scovill Manufacturing Company, Waterbury, Conn., reports the highest number of employees on its payroll since 1929.

Daily Metal Prices for February, 1936

Record of Daily, Highest, Lowest and Average Prices and the Customs Duties

	3	4	5	6	7	10	11	12*	13	14	17	18
Copper c/lb. Duty 4 c/lb.												
Lake (del. Conn. Producers' Prices)	9.375	9.375	9.375	9.375	9.375	9.375	9.375	....	9.375	9.375	9.375	9.375
Electrolytic (del. Conn. Producers' Prices)	9.25	9.25	9.25	9.25	9.25	9.25	9.25	....	9.25	9.25	9.25	9.25
Casting (f.o.b. ref.)	8.95	8.95	8.95	8.95	8.95	8.95	8.95	....	8.95	8.95	8.95	8.95
Zinc (f.o.b. East St. Louis) c/lb. Duty 1¼ c/lb.												
Prime Western (for Brass Special add 0.05)	4.85	4.85	4.85	4.85	4.85	4.85	4.85	....	4.85	4.85	4.85	4.85
Tin (f.o.b. N. Y.) c/lb. Duty Free, Straits	48.125	48.00	48.875	47.75	47.625	47.875	48.125	....	48.00	47.75	48.00	47.75
Lead (f.o.b. St. L.) c/lb. Duty 2½ c/lb.	4.35	4.35	4.35	4.35	4.35	4.35	4.35	....	4.35	4.35	4.35	4.35
Aluminum c/lb. Duty 4 c/lb.	22.00	22.00	22.00	22.00	22.00	22.00	22.00	....	22.00	22.00	22.00	22.00
Nickel c/lb. Duty 3 c/lb.												
Electrolytic 99.9%	35.00	35.00	35.00	35.00	35.00	35.00	35.00	....	35.00	35.00	35.00	35.00
Antimony (Ch.99%) c/lb. Duty 2 c/lb.	12.875	12.875	12.875	12.875	12.875	12.875	12.875	....	12.875	12.875	12.875	13.25
Silver c/oz. Troy, Duty Free	44.75	44.75	44.75	44.75	44.75	44.75	44.75	....	44.75	44.75	44.75	44.75
Platinum $/oz. Troy, Duty Free	33.00	33.00	33.00	33.00	33.00	33.00	33.00	....	33.00	33.00	33.00	33.00
Gold—Official Price[1] $/oz. Troy	35.00	35.00	35.00	35.00	35.00	35.00	35.00	....	35.00	35.00	35.00	35.00

	19	20	21	24	25	26	27	28	High	Low	Aver.
Copper c/lb. Duty 4 c/lb.											
Lake (del. Conn. Producers' Prices)	9.375	9.375	9.375	9.375	9.375	9.375	9.375	9.375	9.375	9.375	9.375
Electrolytic (del. Conn. Producers' Prices)	9.25	9.25	9.25	9.25	9.25	9.25	9.25	9.25	9.25	9.25	9.25
Casting (f.o.b. ref.)	8.95	8.95	8.95	8.95	8.95	8.95	8.95	8.95	8.95	8.95	8.95
Zinc (f.o.b. East St. Louis) c/lb. Duty 1¼ c/lb.											
Prime Western (for Brass Special add 0.05)	4.85	4.85	4.85	4.85	4.90	4.90	4.90	4.90	4.90	4.85	4.867
Tin (f.o.b. N. Y.) c/lb. Duty Free, Straits	48.00	48.125	47.50	47.50	47.50	47.875	48.85	48.25	48.875	47.50	47.972
Lead (f.o.b. St. L.) c/lb. Duty 2½ c/lb.	4.35	4.35	4.35	4.35	4.35	4.40	4.45	4.45	4.45	4.35	4.361
Aluminum c/lb. Duty 4 c/lb.	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00
Nickel c/lb. Duty 3 c/lb.											
Electrolytic 99.9%	35.00	35.00	35.00	35.00	35.00	35.00	35.00	35.00	35.00	35.00	35.00
Antimony (Ch.99%) c/lb. Duty 2 c/lb.	13.25	13.25	13.25	13.25	13.25	13.25	13.25	13.25	13.25	12.875	13.053
Silver c/oz. Troy, Duty Free	44.75	44.75	44.75	44.75	44.75	44.75	44.75	44.75	44.75	44.75	44.75
Platinum $/oz. Troy, Duty Free	33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00
Gold—Official Price[1] $/oz. Troy	35.00	35.00	35.00	35.00	35.00	35.00	35.00	35.00	35.00	35.00	35.00

[1] U. S. Treasury price. * Holiday.

Metal Prices, March 2, 1936

(Import duties and taxes under U. S. Tariff Act of 1930, and Revenue Act of 1932)

NEW METALS

Copper: Lake, 9.375, Electrolytic, 9.25, Casting, 8.95.
Zinc: Prime Western, 4.90. Brass Special, 5.00.
Tin: Straits 48. Pig 99%, 46.625.
Lead: 4.45. **Aluminum,** 19-22. **Antimony,** 13.25.
Nickel: Shot, 36. Elec., 35.

Quicksilver: Flasks, 75 lbs., $79.00. **Bismuth,** $1.00.
Cadmium, $1.05. **Silver,** Troy oz., official price, N. Y., March 2, 44.75. **Gold:** Oz. Troy, Official U. S. Treasury price, March 2, $35.00. **Scrap Gold,** 6¾c. per pennyweight per karat, dealers' quotation. **Platinum,** oz. Troy, $33.00.

Duties: **Copper, 4c. lb.; zinc, 1¾c. lb.; tin, free, lead, 2½c. lb.; aluminum, 4c. lb.; antimony, 2c. lb.; nickel, 3c. lb.; quicksilver, 25c. lb.; bismuth, 7½%; cadmium, 15c. lb.; cobalt, free; silver, free; gold, free; platinum, free.**

INGOT METALS AND ALLOYS

	Cents lb.	U. S. Import Duty	Tax*
No. 1 Yellow Brass	7.75	None	4c. lb.[1]
85-5-5-5	9.50	None	4c. lb.[1]
88-10-2	12.50	None	4c. lb.[1]
80-10-10	11.00	None	4c. lb.[1]
Manganese Bronze (60,000 t. s. min.)	9.75	None	4c. lb.[1]
Aluminum Bronze	13.75	None	4c. lb.[1]
Monel Metal Shot or Block	28	25% a.v.	None
Nickel Silver (12% Ni)	11.50	20% a.v.	4c. lb.[1]
Nickel Silver (15% Ni)	15.00	20% a.v.	4c. lb.[1]
No. 12 Aluminum	16.50-20	4c. lb.	None
Manganese Copper, Grade A (30%)	18-23	25% a.v.	3c. lb.[1]
Phosphor Copper, 10%	11.25-14	3c. lb.	4c. lb.[1]
Phosphor Copper, 15%	13.25-15	3c. lb.	4c. lb.[1]
Silicon Copper, 10%	18.30	45% a.v.	4c. lb.[1]
Phosphor Tin, no guarantee	61-75	None	None
Iridium Platinum, 5%	$35-36	None	None
Iridium Platinum, 10%	$36-37	None	None

*Duty is under U. S. Tariff Act of 1930; tax under Section 60 (7) of Revenue Act of 1932.
[1]On copper content. [2]On total weight. "a. v." means ad valorem.

OLD METALS

Dealers' buying prices, wholesale quantities:	Cents lb.	Duty	U. S. Import Tax
Heavy copper and wire, mixed	7¼ to 7½	Free	4c. per pound on copper content
Light copper	6¼ to 6½	Free	
Heavy yellow brass	4½ to 4¾	Free	
Light brass	3¾ to 4	Free	
No. 1 composition	6¼	Free	
Composition turnings	6⅛	Free	
Heavy soft lead	3.90 to 4	2⅛c.lb	
Old zinc	2.85 to 3.00	1½c.lb.	
New zinc clips	3¾	1½c.lb.	
Aluminum clips (new, soft)	14 to 14.25	4c.lb.	
Scrap aluminum, cast	12.25 to 12.50	4c.lb.	
Aluminum borings—turnings	6½ to 6¾	4c.lb.	None.
No. 1 pewter	29 to 30	Free	
Electrotype	4 to 4¼	2⅛c.lb.*	
Nickel anodes	29½ to 31	10%	
Nickel clips, new	32 to 33	10%	
Monel scrap	11 to 19	10% a.v.	

*On lead content.

Wrought Metals and Alloys

The following are net BASE PRICES per pound, to which must be added extras for size, shape, quantity, packing, etc., or discounts, as shown in manufacturers' price lists, effective since January 13, 1936. Basic quantities on most rolled or drawn brass and bronze items below are from 2,000 to 5,000 pounds; on nickel silver, from 1,000 to 2,000 pounds.

COPPER MATERIAL

	Net base per lb.	Duty*
Sheet, hot rolled	16½c.	2½c. lb.
Bare wire, soft, less than carloads	13 c.	25% a. v.
Seamless tubing	17 c.	7c. lb.

*Each of the above subject to import tax of 4c. lb. in addition to duty, under Revenue Act of 1932.

BRASS AND BRONZE MATERIAL

	Yellow Brass	Red Brass 80%	Comm'l. Bronze	Duty	
Sheet	14⅝c.	15½c.	16⅜	4c. lb.	U. S. Import Tax 4c. lb. on copper content.
Wire	15⅛c.	16 c.	16⅞	25%	
Rod	13⅛c.	16 c.	16¾	4c. lb.	
Angles, channels	22⅝c.	23¾c.	24⅜	12c. lb.	
Seamless tubing	16⅞c.	17½c.	18⅜	8c. lb.	
Open seam tubing	22⅝c.	23¾c.	24⅜	20% a.v.	

NICKEL SILVER

Net base prices per lb. (Duty 30% ad valorem.)

Sheet Metal		Wire and Rod	
10% Quality	23⅞c.	10% Quality	26¾c.
15% Quality	26 c.	15% Quality	31⅛c.
18% Quality	27¼c.	18% Quality	34⅜c.

TOBIN BRONZE AND MUNTZ METAL

(Duty 4c. lb.; import tax 4c. lb. on copper content.)

Net base prices per pound.	
Tobin Bronze Rod	16¾c.
Muntz or Yellow Rectangular and other sheathing	17⅞c.
Muntz or Yellow Metal Rod	14¼c.

ALUMINUM SHEET AND COIL

(Duty 7c. per lb.)

Aluminum sheet, 18 ga., base, ton lots, per lb.	32.80
Aluminum coils, 24 ga., base price, ton lots, per lb.	30.50

ROLLED NICKEL SHEET AND ROD

(Duty 25% ad valorem, plus 10% if cold worked.)

Net Base Prices

Cold Drawn Rods	49c.	Cold Rolled Sheet	53c.
Hot Rolled Rods	44c.	Standard Sheet	48c.

MONEL METAL SHEET AND ROD

(Duty 25% ad valorem, plus 10% if cold worked.)

Hot Rolled Rods (base)	34	Standard Sheets (base)	38
Cold Drawn Rods (base)	39	Cold Rolled Sheets (base)	43

SILVER SHEET

Rolled sterling silver (March 2) 47c. per Troy oz. upward according to quantity. (Duty, 65% ad valorem.)

ZINC AND LEAD SHEET

	Cents per lb. Net Base	Duty
Zinc sheet, carload lots, standard sizes and gauges, at mill, less 7 per cent discount	9.50	2c. lb.
Zinc sheet, 1200 lb. lots (jobbers' price)	10.25	2c. lb.
Zinc sheet, 100 lb. lots (jobbers' price)	14.25	2c. lb.
Full Lead Sheet (base price)	8.00	2¾c. lb.
Cut Lead Sheet (base price)	8.25	2⅜c. lb.

BLOCK TIN, PEWTER AND BRITANNIA SHEET

(Duty Free)

This list applies to either block tin or No. 1 Britannia Metal Sheet, No. 23 B. & S. Gauge, 18 inches wide or less; prices are all f. o. b. mill:

500 lbs. over	15c. above N. Y. pig tin price
100 to 500 lbs.	17c. above N. Y. pig tin price
Up to 100 lbs.	25c. above N. Y. pig tin price
Up to 100 lbs.	25c. above N. Y. pig tin price

Supply Prices on page 122.

Supply Prices, March 2, 1936

ANODES

Prices, except silver, are per lb. f.o.b., shipping point, based on purchases of 500 lbs. or more, and subject to changes due to fluctuating metal markets.

Copper:	Cast	16½c. per lb.
	Electrolytic, full size, 14¼c. cut to size	14¼c. per lb.
	Rolled oval, straight, 14¾c.; curved,	15¾c. per lb.
Brass:	Cast	17 c. per lb.
Zinc:	Cast	10⅛c. per lb.
Nickel:	90-92%	.45 per lb.
	95-97%	.46 per lb.
	99%+cast, 47c.; rolled, depolarized, 48.	
Silver:	Rolled silver anodes .999 fine were quoted March 2, from 48c. per Troy ounce upward, depending on quantity.	

WHITE SPANISH FELT POLISHING WHEELS

Diameter	Thickness	Under 50 lbs.	50 to 100 lbs.	Over 100 lbs.
10-12-14 & 16	1" to 2"	$2.95/lb.	$2.65/lb.	$2.45/lb.
10-12-14 & 16	2 to 3½	2.85	2.55	2.35
6-8 & over 16	1 to 2	3.05	2.75	2.55
6-8 & over 16	2 to 3½	3.00	2.70	2.45
6 to 24	Under ½	4.25	3.95	3.75
6 to 24	½ to 1	3.95	3.65	3.45
6 to 24	Over 3½	3.35	3.05	2.85

Any Quantity

4 to 6	Under ½,	$5.00	½-1, $4.85	1 to 3,	$4.75
1½ to 4	"	5.55	" 5.40	"	5.35
1 to ½	"	5.85	" 5.70	"	5.60

Extras: 25c per lb. on wheels, 1 to 6 in. diam., over 3 in. thick. On grey Mexican wheels deduct 10c. per lb. from above prices.

COTTON BUFFS

Full disc open buffs, per 100 sections when purchased in lots of 100 or less are quoted:

16" 20 ply 84/92 Unbleached	$71.13
14" 20 ply 84/92 Unbleached	54.58
12" 20 ply 84/92 Unbleached	41.09
16" 20 ply 80/92 Unbleached	59.37
14" 20 ply 80/92 Unbleached	45.64
12" 20 ply 80/92 Unbleached	34.45
16" 20 ply 64/68 Unbleached	51.26
14" 20 ply 64/68 Unbleached	39.47
12" 20 ply 64/68 Unbleached	29.86
⅜" Sewed Buffs, per lb., bleached or unbleached	48c. to 1.12

CHEMICALS

These are manufacturers' quantity prices and based on delivery from New York City.

Acetone C. P.	lb.	.09½-.15
Acid—Boric (Boracic) granular, 99½+% ton lots	lb.	.05¼-.05¾
Chromic, 400 or 100 lb. drums		.16¾
Hydrochloric (Muriatic) Tech., 20 deg., carboys	lb.	.03
Hydrochloric, C. P., 20 deg., carboys	lb.	.06½
Hydrofluoric, 30%, bbls.	lb.	.07-.08
Nitric, 36 deg., carboys	lb.	.05-.06¼
Nitric, 42 deg., carboys	lb.	.07-.08
Sulphuric, 66 deg., carboys	lb.	.02
Alcohol—Butyl, drums	lb.	.09½-.12
Denatured, drums	gal.	.475-.476
Alum—Lump, barrels	lb.	.03¼-.03½
Powdered, barrels	lb.	.0340-.0365
Ammonia, aqua, com'l., 26 deg., drums, carboys	lb.	.02½-.05
Ammonium—Sulphate, tech., bbls.	lb.	.03½-.05
Sulphocyanide, technical crystals, kegs	lb.	.55-.58
Arsenic, white kegs	lb.	.04½-.05
Asphaltum, powder, kegs	lb.	.23-.41
Benzol, pure, drums	gal.	.41
Borax, granular, 99½+%, ton lots	lb.	.0245-.0295
Cadmium oxide, 50 to 1,000 lbs.	lb.	.85
Calcium Carbonate (Precipitated Chalk), U. S. P.	lb.	.05¾-.07½
Carbon Bisulphide, drums	lb.	.05½-.06
Chrome, Green, commercial, bbls.	lb.	21½-23½
Chromic Sulphate, drums	lb.	.33-.55
Copper—Acetate (Verdigris)	lb.	.21
Carbonate, 53/55% cu., bbls.	lb.	.15½
Cyanide (100 lb. kgs.)	lb.	.38-.40
Sulphate, tech., crystals, bbls.	lb.	4.55-5c.
Cream of Tartar Crystals (Potassium Bitartrate)	lb.	.20¼-.20½
Crocus Martis (Iron Oxide) red, tech., kegs.,	lb.	.07
Dextrin, yellow, kegs	lb.	.05-.08
Emery Flour	lb.	.06
Flint, powdered	ton	30.00
Fluorspar, bags	lb.	.03½
*Gold Chloride	oz.	$18¼-23
*Gold Cyanide, Potassium		$15.45
*Gold Cyanide, Sodium		$17.10
Gum—Sandarac, prime, bags	lb.	.50
Shellac, various grades and quantities	lb.	.21-.31
Iron Sulphate (Copperas), bbls.	lb.	.01½
Lead—Acetate (Sugar of Lead), bbls.	lb.	.10-.13½
Oxide (Litharge), bbls	lb.	.12½
Mercury Bichloride (Corrosive Sublimate)	lb.	$1.58
Methanol, (Wood Alcohol) Pure, drums	gal.	.42½
Nickel—Carbonate, dry, bbls.	lb.	.35-.41
Chloride, bbls.	lb.	.18-.22
Salts, single, 425 lb. bbls.	lb.	.13½-.14½
Salts, double, 425 lb. bbls.	lb.	.13½-.14½
Paraffin	lb.	.05-.06
Phosphorus—Duty free, according to quantity	lb.	.35-.40
Potash Caustic Electrolytic 88-92% broken, drums.	lb.	.07¼-.08½
Potassium—Bichromate, casks (crystals)	lb.	.09
Carbonate, 96-98%	lb.	.07⅝
Cyanide, 165 lbs. cases, 94-96%	lb.	.57½
Pumice, ground, bbls.	lb.	.02½
Quartz, powdered	ton	$30.00
Rosin, bbls.	lb.	.04½
Rouge—Nickel, 100 lb. lots	lb.	.08
Silver and Gold	lb.	.65
Sal Ammoniac (Ammonium Chloride) in bbls.	lb.	.05-.07½
*Silver—Chloride, dry, 100 oz. lots	oz.	.38
Cyanide, 100 oz. lots	oz.	.45-.50
Nitrate, 100 ounce lots	oz.	.32¾
Soda Ash, 58%, bbls.	lb.	.0252
Sodium—Cyanide, 96 to 98%, 100 lbs.	lb.	.17½-.22
Hyposulphite, kegs, bbls.	lb.	.03½-.06½
Metasilicate, granular, bbls.	lb.	3.15-3.30
Nitrate, tech., bbls.	lb.	.02¼
Phosphate, tribasic, tech., bbls.	lb.	.0350
Silicate (Water Glass), bbls.	lb.	.01½
*Stannate, drums	lb.	.32-.35
Sulphocyanide, drums	lb.	.30-.45
Sulphur (Brimstone), bbls.	lb.	.02
*Tin Chloride, 100 lb. kegs	lb.	.37
Tripoli, powdered	lb.	.03
Trisodium Phosphate—see Sodium Phosphate.		
Wax—Bees, white, ref. bleached	lb.	.60
Yellow, No. 1	lb.	.45
Whiting, Bolted	lb.	.02½-.06
Zinc—Carbonate, bbls.	lb.	.11-.12
Cyanide (100 lb. kegs)	lb.	.38
Chloride, drums, bbls.	lb.	.07½-.10
Sulphate, bbls.	lb.	.028-.037

*Subject to fluctuations in metal prices.